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Original Article

Periodontitis and identification of undiagnosed hyperglycemia

Periodontite e identificação da hiperglicemia não diagnosticada

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Resumo

Introdução: Indivíduos com pré-diabetes apresentam níveis glicêmicos alterados, geralmente são assintomáticos e apresentam risco aumentado para desenvolver diabetes mellitus tipo 2. **Objetivo**: Identificar a prevalência de indivíduos periodontais com hiperglicemia não diagnosticada e os fatores de impacto associados. **Material e método**: Cinquenta e seis pacientes com periodontite e sem autorrelato de diabetes, usuários de serviços de clínica odontológica da Universidade Federal de Juiz de Fora foram incluídos nesta pesquisa, durante um ano e meio de avaliação experimental. Foram avaliados dados socioeconômicos e demográficos, padrões antropométricos, glicemia capilar de jejum e exame periodontal completo (seis sítios por dente). **Resultado**: A amostra foi composta por 58,9% do sexo feminino, média de idade de 53 anos, 58,9% obesidade / sobrepeso e 45,3% com baixa escolaridade. Um total de 28,6% (n=16) participantes tinham hiperglicemia não diagnosticada (entre 100 a 160 mm / dL), dos quais 81,3% eram obesos / com sobrepeso, 25% eram fumantes, 56,3% relataram ter histórico de diabetes na família, 93,8% tinham renda familiar de até 2 salários mínimos brasileiros. Os valores de IMC foram maiores no grupo de pacientes com hiperglicemia (29,8 ± 5,7, p = 0,03) em comparação ao grupo sem hiperglicemia (26,6 ± 5,6). Pacientes com hiperglicemia apresentaram maior número de sítios com perda clínica de inserção (CAL) entre 4 e 6 mm (p = 0,04) quando comparados ao grupo normoglicêmico. **Conclusão**: A perda de inserção de CAL não diagnosticada entre 4 e 6 mm devido à periodontite do que indivíduos normoglicêmicos.

Descritores: Hiperglicemia; estado pré-diabético; diabetes mellitus; periodontite; fatores de risco.

Abstract

Introduction: Individuals with pre-diabetes have altered glycemic levels, are generally asymptomatic, and are at increased risk for developing type 2 diabetes mellitus. **Objective:** Identify the prevalence of periodontal individuals with undiagnosed hyperglycemia and associated impact factors. **Material and method:** Fifty-six patients with periodontitis and without diabetes self-report, users of dental clinic services at Federal University of Juiz de Fora were included in this research, during one year and a half of experimental evaluation. Socioeconomic and demographic data, anthropometric patterns, fasting capillary blood glucose, and complete periodontal examination (six sites *per* tooth) were evaluated. **Result:** The sample consisted of 58.9% female, mean age 53 years old, 58.9% obese/overweight and 45.3% had a low level of education. A total of 28.6% (n=16) participants had undiagnosed hyperglycemia (between 100 to 160 mm / dL), of which 81.3% were obese/overweight, 25% were smokers, 56.3% reported having a history of diabetes in the family, 93.8% had a family income up to 2 brazilian´s minimum wages. BMI values were higher in the group of patients with hyperglycemia (29.8 ± 5.7, p = 0.03) compared to the group without hyperglycemia (26.6 ± 5.6). Patients with hyperglycemia had a greater number of sites with clinical attachment loss (CAL) between 4 and 6 mm (p = 0.04) when compared with the normoglycemic group. **Conclusion:** Undiagnosed CAL attachment loss between 4 and 6 mm due to periodontitis than normoglycemic individuals.

Descriptors: Hyperglycemia; prediabetic state; diabetes mellitus; periodontitis; risk factors.

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia and considered a chronic disease that requires patient self-care and medical care to prevent acute complications[1]. In Brazil, the prevalence of DM in adults was estimated at 7.6% in the most comprehensive epidemiological study carried out in the country[2]. In this context, it is known that many diabetic patients remain undiagnosed[3] and type 2 diabetes (DM2) is a serious public health problem, generally silent in its early stages, and as such, it often remains unrecognized for years[4]. Data show that there are 463 million adults aged between 20 and 79 years with diabetes in the world and one in two individuals (232 million) have not been diagnosed[5].

Therefore, studies indicate that DM can increase the risk of developing periodontal disease by two or three times[6], affecting its prevalence, severity and progression[7]. Additionally, the extent/severity of periodontitis can influence glycemic control and the development of complications in these patients[7].

The glucometer has been used in epidemiological research and, although, with limitations, it has become an alternative because it is an economical, accurate, fast, and portable method that contributes to the systemic assessment of the patient[8]. The use of the glucose meter and the capillary blood glucose testing has been recommended in dental clinics, however, few professionals regularly use it in their offices[9].

Therefore, the aim of this study was to identify the prevalence of periodontal individuals with undiagnosed hyperglycemia and associated impact factors in periodontitis individuals seeking treatment in the dental clinics of the Federal University of Juiz de Fora, Governador Valadares, Brazil.

MATERIAL AND METHOD

Ethical Aspects

This study was approved by the Human Research Ethics Committee of the Federal University of Juiz de Fora (protocol number: 3.410.480) and was conducted according to the guidelines established by the Declaration of Helsinki. All volunteers were informed about the aims and method of this study, and gave their written consent to participate by signing a consent form.

Study Design, Setting, and Participants

Patients were recruited from the Dental Clinic of the Department of Dentistry, at Federal University of Juiz de Fora (UFJF), Brazil, between August 2018 and December 2019.

As inclusion criteria, all subjects who participated in this study had the diagnosis of periodontitis[10], presented a minimum of 12 natural teeth and aged 18 years or older. The following exclusion criteria were considered: self-reported individuals with DM, prediabetes, pregnant or lactating women and previous periodontal treatment in the last six months.

Risk Questions

The sample was subjected to a physical examination in which the following criteria were evaluated: waist circumference (WC), body mass (in kg), height, and the body mass index (BMI) recommended by the *World Health Organ Tech Rep Ser* (WHO)[11]. All completed an identification questionnaire that contained: name, age, gender, skin color self-report, smoking habit, family income, education level, family history and, self-report of diabetes, hypertension, high cholesterol, high triglyceride, and obesity. Average household income was categorized into five levels or social classes[12].

Periodontal Examination

The complete periodontal examination was performed on all teeth, except of the third molars, by three trained evaluators. Measurements were made at six sites per tooth using a Williams millimeter-periodontal probe. The evaluation considered: missing teeth, visible plaque index (VPI), gingival bleeding index (GBI), probing depth (PD), bleeding on probing (BOP), clinical attachment loss (CAL), suppuration, degree of furcation injury, and number of teeth with tooth mobility.

Capillary Blood Glucose Test

The fasting capillary blood glucose test was performed by a single previously trained examiner. Patients were instructed to fast from 8 hours to 10 hours until the appointment and a blood sample was obtained at the fingertip with disposable sterile lancets and applied to specific strips for reading on the monitor, (Accu-Chek Active®, São Paulo, Brazil). All care was taken to minimize any risk of contamination during its assessment. Patients with identified hyperglycemia (≥ 100mg / dL) received instructions about the importance of seeking a doctor for systemic evaluation, practicing physical activity regularly, eating healthy diet, as well as the bidirectional relationship between periodontal disease and DM.

Data Processing and Statistical Analysis

Data analysis was performed using a specific program (Bioestat 5.3, Instituto Mamirauá, PA, Brazil), considering the null hypothesis based on the absence of difference between the groups, with a significance level of 5%. The unit of analysis was the patient. The data were submitted to the Shapiro-Wilk normality test. Continuous and ordinal data were analyzed using the t-test, in the case of the normal distribution; or by the Mann-Whitney test, when the distribution was non-normal. Nominal dichotomous data were analyzed using Fisher's Exact test, and the others using the Mann-Whitney test. The values were presented with mean and standard deviation.

RESULT

In the present study, 63 patients met the inclusion/exclusion criteria, however, a total of seven patients did not accept to participate in the research and, therefore, were not included in the analysis. The convenience sample, composed of 56 patients, had a mean age of 52.9 ± 9.3 years. A total of 28.6% (n = 16) participants had undiagnosed hyperglycemia (between 100 and 160 mm / dL) and in this group the BMI was, on average, 29.8 ± 5.7 (p = 0.03). In assessing the characterization of the groups, it was observed that the values of

blood glucose, body mass, BMI were higher in the group of patients with hyperglycemia, compared to the group without hyperglycemia ($p < 0.05$) (Table 1).

Table 1. Mean values (standard deviation) of patients characterization data (n = 56)

Rated parameter	Total	Experimental groups		
		Glucose <100mg/dL (n = 40)	Glucose ≥100mg/dL (n = 16)	P value
Age (Years)	52.9 (9.3)	53.1 (9.1)	52.6 (10.0)	ns*
Glucose (mg/dL)	94.4 (13.9)	87.9 (7.0)	110.5 (13.6)	<0.0001*
Body mass (kg)	73.6 (15.5)	71.1 (14.4)	79.8 (16.3)	0.04*
Height (m)	1.6 (0.1)	1.6 (0.1)	1.6 (0.1)	ns*
Abdominal circumference (cm)	96.6 (13.8)	94.8 (11.8)	100.9 (17.3)	ns*
Body mass index (kg/cm²)	27.5 (5.8)	26.6 (5.6)	29.8 (5.7)	0.03*

Source: Elaborated by the author (2020). n: number, sample size; ns: Not significant, $p > 0.05$. * p: value calculated by the Mann-Whitney test.

Most participants in the group with hyperglycemia had a family income of up to two minimum wages (93.8%) (Table 2).

Table 2. Characterization of the frequency distribution (percentage) of the socioeconomic and demographic data of the sample (n = 56)

Rated parameter	Total n (%)	Experimental groups		P value
		Glucose <100 mg/dL (n = 40)	Glucose ≥100 mg/dL (n = 16)	
Sex				
Male	23 (41.1)	16 (40.0)	7 (43.7)	ns*
Feminine	33 (58.9)	24 (60.0)	9 (56.3)	
Skin color				
White	17 (30,4)	12 (30,0)	5 (31.2)	ns**
Parda	26 (46.4)	20 (50.0)	6 (37.5)	
Black	13 (23.2)	8 (20.0)	5 (31.3)	
Income				
1-2 salary	41 (73.2)	26 (65.0)	15 (93.7)	
3-4 salary	14 (25.0)	13 (32.5)	1 (6.3)	ns**
4-10 salary	1 (1.8)	1 (2.5)	0.0	
10-15 salary	0.0	0.0	0.0	
> 15 salary	0.0	0.0	0.0	
Education				
Incomplete elementary school	27 (48,2)	18 (45.0)	9 (56.3)	
Complete primary education	3 (5.4)	2 (5.0)	1 (6.3)	
Incomplete high school	5 (8.9)	3 (7.5)	2 (12.5)	ns**
Complete high school	16 (28.6)	14 (35.0)	2 (12.5)	
Incomplete higher education	2 (3.5)	1 (2.5)	1 (6.3)	
Complete higher education	3 (5.4)	2 (5.0)	1 (6.3)	

Source: Elaborated by the author (2020). n: number, sample size; ns: Not significant, $p > 0.05$. * p: value calculated by the Fisher's Exact test. ** p: value calculated by the Mann-Whitney test.

There were no significant differences regarding the behavioral data and systemic conditions of the sample (Table 3).

Table 3. Characterization of the frequency distribution (percentage) of the behavioral data and systemic conditions of the sample (n = 56)

Rated parameter	Total n (%)	Experimental groups		P value
		Glucose <100 mg/dL (n = 40)	Glucose ≥100 mg/dL (n = 16)	
Smoke Status				
Non smokers	27 (48.2)	21 (52.5)	6 (37.5)	ns*
Ex-smokers	16 (28.6)	10 (25.0)	6 (37.5)	
Smokers	13 (23.2)	9 (22.5)	4 (25.0)	
Body mass index				
Normal (18.5 <BMI< 24.9)	23 (41.1)	20 (50.0)	3 (18.8)	ns*
Overweight (25 < BMI< 29.9)	21 (37.5)	13 (32.5)	8 (50.0)	
Obese (BMI>= 30)	12 (21.4)	7 (17.5)	5 (31.2)	
Number of cigarettes/day				
0 - 10 cigarettes/day	6 (10.7)	4 (10.0)	2 (12.5)	ns*
11 - 30 cigarettes/day	5 (8.9)	3 (7.5)	2 (12.5)	
> 30 cigarettes/day	2 (3.6)	2 (5.0)	0.0	
Self-report				
Diabetes	0.0	0.0	0.0	
Hypertension	17 (30.4)	10 (25.0)	7 (43.8)	ns**
High cholesterol	6 (10.7)	3 (7.5)	3 (18.8)	
Triglycerides	8 (14.3)	5 (12.5)	3 (18.8)	
Obesity	6 (10.7)	4 (10.0)	2 (12.5)	
Family history				
Diabetes	24 (42.9)	15 (37.5)	9 (56.3)	
Hypertension	35 (62.5)	24 (60.0)	11 (68.8)	ns**
High cholesterol	16 (28.6)	13 (32.5)	3 (18.8)	
Triglycerides	10 (17.9)	7 (17.5)	3 (18.8)	
Obesity	12 (21.4)	6 (15.0)	6 (37.5)	

Source: Elaborated by the author (2020). n: number, sample size; ns: Not significant, p > 0.05. * p: value calculated by the Mann-Whitney test. ** p: value calculated by the Fisher's Exact test.

Table 4 showed that patients with hyperglycemia had a greater number of sites with CAL between 4 and 6 mm (p = 0.04). It was also noted that the average number of missing teeth was 6.2 ± 4.1. Regarding periodontal diagnosis, there was no significant difference between the groups (data not shown).

Table 4. Mean (standard deviation) of the patients' periodontal parameters (n = 56)

Rated parameter	Total	Experimental groups		P value
		Glucose <100 mg/dL (n = 40)	Glucose≥100 mg/dL (n = 16)	
Number of missing teeth	6.2 (4.1)	6.5 (4.4)	5.6 (3.2)	ns*
VPI (% of positive sites)	63.0 (29.6)	62.6 (29.6)	64.0 (29.4)	ns*
GBI (% of positive sites)	29.4 (26.8)	29.4 (25.4)	29.3 (30.2)	ns*
BOP (% of positive sites)	41.1 (26.2)	42.2 (26.2)	38.3 (26.1)	ns*
PD (mm)	2.6 (0.7)	2.6 (0.7)	2.6 (0.5)	ns*
Sites PD ≤ 3 mm (%)	84.2 (16.6)	84.0 (17.7)	84.5 (13.2)	ns**
Sites PD 4 – 6 mm (%)	13.4 (12.8)	13.4 (13.4)	13.3 (11.2)	ns**
Sites PD ≥ 7 mm (%)	2.3 (4.9)	2.4 (5.5)	2.2 (3.2)	ns**
CAL (mm)	2.5 (1.4)	2.4 (1.4)	3.0 (1.4)	ns*

Table 4. Continued…

Rated parameter	Total	Experimental groups		P value
		Glucose <100 mg/dL (n = 40)	Glucose≥100 mg/dL (n = 16)	
Sites CAL ≤ 3 mm (%)	74.4 (26.3)	78.5 (23.3)	64.1 (30.2)	ns**
Sites CAL 4 – 6 mm (%)	20.2 (19.7)	16.7 (17.1)	28.9 (23.0)	0,04**
Sites CAL ≥ 7 mm (%)	5.9 (9.9)	5.5 (10.3)	6.9 (9.0)	ns**
Number of PD ≥ 4 mm	19.3 (20.4)	19.0 (21.9)	20.1 (16.2)	ns*
Number of PD ≥ 5 mm	12.1 (9.7)	12.3 (10.5)	11.6 (7.6)	ns*
Number of sites with suppuration	0.6 (1.8)	0.7 (2.0)	0.4 (1.2)	ns**
Number of furcation injury sites	1.8 (2.5)	1.8 (2.6)	1.8 (2.1)	ns**
Number of teeth with mobility	2.2 (4.8)	2.2 (5.2)	2.1 (3.9)	ns**

Source: Elaborated by the author (2020). n: number, sample size; ns: Not significant, p > 0.05. * p: value calculated by the Fisher's Exact test. ** p: value calculated by the t-test.

DISCUSSION

Scientific data reveals that one out of every two individuals with DM in the world has not been diagnosed[5] and that DM2 is generally silent in its early stages and often remains unrecognized for years[4]. In patients with periodontitis, it is observed that the extent/severity of periodontitis can influence glycemic control and the development of complications in these individuals[7]. In addition, DM can increase the risk of developing periodontal disease by two or three times[6], affecting its prevalence, severity, and progression[7]. A sample of the present study found a prevalence of 28.6% of undiagnosed hyperglycemia among individuals with periodontitis.

Some studies that evaluated periodontal parameters, considering a population sample without a diagnosis of periodontitis, found prevalence values higher than our study. In the study by Lalla et al.[3], a prevalence of 36% of undiagnosed hyperglycemia was demonstrated in 506 individuals, aged over 30 years, who attended dental clinics in the United States, regardless of periodontal diagnosis. Other studies have found a prevalence equal or greater than 40% of unidentified hyperglycemia[13,14]. These studies showed differences in terms of sample size and patient selection criteria, in which individuals older than 40 years were included. However, some studies have evaluated patients with periodontitis and found results in agreement with the present study. Holm et al.[15] identified a prevalence of 30.2% of undiagnosed hyperglycemia among 291 individuals in Denmark. On the other hand, the prevalence found by Mataftsi et al.[16] in a sample of 139 individuals from Greece was 24.5%. Bossart et al.[17] analyzed a sample with a similar size (n = 50) and the prevalence was 34%. Factors such as obesity, individuals' advanced age, smoking, and different locoregional habits of the samples might influence the different results about prevalence of undiagnosed hyperglycemia among the studies.

An important result of this study was the greater CAL between 4 and 6 mm found in hyperglycemic patients (p = 0.04). Similarly, Alasqah et al.[18] evaluated a sample categorized according to HbA1c values as group 1 (pre-diabetes), group 2 (type 2 diabetes) and group 3 (control). The CAL were significantly higher in group 1 and 2 when compared to group 3. Mataftsi et al.[16] identified that individuals with HbA1c ≥ 5.7% had significantly more sites with CAL > 5 mm. Likewise, a study with a representative sample of individuals with periodontitis identified that individuals with hyperglycemia had greater CAL when compared to those with normoglycemia[19].

Regarding the assessment of anthropometric patterns, body mass and BMI were significantly associated with hyperglycemia (p < 0.05). Since the sample was composed of periodontal individuals, this data is in agreement with previous reports that demonstrated that periodontitis

is associated with obesity determined by BMI[20,21]. It is known that obesity increases insulin resistance and thus induces hyperglycemia[22], which may explain the fact that individuals with hyperglycemia had an average BMI of 29.8 ± 5.7, which represents advanced overweight/obesity. Several studies showed the association of BMI with hyperglycemia[13,14,23]. Furthermore, Holm et al.[15] analyzed a population with and without periodontitis and found that individuals with periodontitis and overweight have a higher risk factors of developing pre-diabetes and DM. In the study, they found a significant association between periodontitis, BMI and waist circumference ($p < 0.05$). Thus, periodontal patients with undiagnosed hyperglycemia in the present study may, in general, be at risk for developing diseases associated with obesity and diabetes.

Regarding periodontal diagnosis, there was no significant difference between the groups. It is noteworthy that the sample size when subdivided by categories of the classification is a limiting factor for statistical differences. However, a tendency was observed: 75% of the subgroup with hyperglycemia showed more advanced stages of periodontitis (stages III or IV) whereas in the normoglycemic subgroup this prevalence was 72.5% (no significant result, data not shown). In the literature, a greater proportion of patients with undiagnosed hyperglycemia exhibited Stage III periodontitis compared to periodontally healthy individuals[24].

The convenience sample, although representative of the number of periodontal patients seeking treatment at the dental clinics of the UFJF Campus Governador Valadares for a period of one and a half years, is a limiting factor of this study. Additionally, the use of the fasting capillary blood glucose test, and not the intravenous fasting blood glucose, represents a lower accuracy in the result, however, throughout the study care was taken to always guide the patient to be fasting between 8 to 10 hours.

Our result suggests that a simple screening approach in university dental clinics, involving a complete periodontal evaluation associated with a careful anamnesis for the assessment of risk factors and the fasting capillary blood glucose test using glucometers (simple, low-cost, and easy to handle) to identify patients with altered hyperglycemia without a diagnosis must be recommended. Thus, by identifying, guiding, and referring these patients for medical evaluation, the dentist may contribute to the early diagnosis of metabolic diseases. New research, more representative of the population, is necessary to allow more careful analysis of the impact factors of undiagnosed hyperglycemia in periodontal patients.

CONCLUSION

Within the limits of this study, it was possible to conclude that the prevalence of undiagnosed hyperglycemia among individuals with periodontitis was relevant, and that hyperglycemic individuals had higher body mass index and greater loss of insertion than normoglycemic individuals.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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