

Association Between Severe Periodontitis and Obesity Degree: A Preliminary Study

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Purpose: To evaluate the association of severe periodontitis with overweight and obesity.

Material and Methods: Full-mouth periodontal examination was performed on a random sample of 80 obese, 69 overweight and 87 normal-weight individuals (≥ 18 years). Severe periodontitis was defined using the Centers for Disease Control and Prevention – American Academy of Periodontology (CDC-AAP) case classification. Weight (kg) and height (m) were measured by a single examiner, body mass index (BMI) was calculated, and the subjects were classified as normal range, overweight and obese according to World Health Organization definitions. Interviews using a structured questionnaire were performed to collect data on demographics as well as socioeconomic and health status. Chi-squared and logistic regression tests were used to assess the association between severe periodontitis and obesity ($p \leq 0.05$).

Results: Although severe periodontitis was significantly associated with obesity (OR = 3.25, 95% CI = 1.27–8.31, $p = 0.01$), it was not associated with overweight ($p = 0.59$).

Conclusions: In the present study, severe periodontitis was associated with obesity but not with overweight. Patients diagnosed with obesity should be referred for periodontal evaluation.

Key words: cross-sectional study, obesity, periodontal disease, risk factors

Oral Health Prev Dent 2019; 17: 173–177.
doi: 10.3290/j.ohpd.a42374

Submitted for publication: 10.08.17; accepted for publication: 27.12.17

Obesity is a complex, multifaceted disease resulting from interactions between genetics and lifestyle. It causes major adverse health outcomes, such as type 2 diabetes, cardiovascular disease, dyslipidemia, chronic kidney diseases, and cancer, which are serious problems worldwide.^{27,28} Obesity rates are dramatically increasing in developed and developing countries. If recent trends continue unabated, by 2030, the absolute numbers could rise to a total of 2.16 billion overweight and 1.12 billion obese indi-

viduals, or 38% and 20% of the world's adult population, respectively.²¹

Periodontitis is a chronic infectious disease caused predominantly by bacteria that release endotoxins which activate pro-inflammatory cytokines that would affect the supporting tissues of teeth and induce the loss of alveolar bone, cementum and periodontal ligament.³ Periodontal disease can also be influenced by genetics and lifestyle.³¹ The systemic inflammation associated with obesity may increase susceptibility to chronic infectious diseases, which may explain how obesity would affect the development of periodontal diseases.²⁶ However, whether obesity and overweight are associated with periodontitis is still under debate. Many clinical studies have shown that overweight status, obesity, weight gain, and increased waist circumference are risk factors for the development of periodontitis or the worsening of periodontal status.^{2,6,15,16,18,21,22,23,30} However, other studies showed that overweight or obesity are not a risk factor for periodontal destruction.^{9,24,25}

The null hypothesis of the present study was that severe periodontitis is associated with obesity and overweight. Therefore, the aim of this cross-sectional study was to evaluate the association of periodontitis with obesity and overweight.

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Table 1 Comparison between obese, overweight and normal-weight participants according to demographics, socioeconomic status, and periodontal status (N = 236)

Variables	Normal weight	Overweight	Obese	Total sample	p-value
Gender					
Female	69 (79.3)	51 (73.9)	64 (80.0)	184	0.62
Male	18 (20.7)	18 (26.1)	16 (20.0)	52	
Age (years)					
18-34	52 (59.8)	30 (43.5)	45 (56.3)	127	0.11
≥ 35	35 (40.2)	39 (56.5)	35 (43.8)	109	
Education					
Up to high school	10 (11.5)	11 (15.9)	7 (63.8)	124	0.39
University degree	77 (88.5)	58 (84.1)	73 (91.3)	112	
Income (US\$)					
> 1288.78	51 (58.6)	36 (52.2)	39 (48.8)	126	0.43
≤ 1288.78	36 (41.4)	33 (47.8)	41 (51.2)	110	
Plaque index					
< 40%	83 (95.4)	66 (95.7)	62 (77.5)	211	<0.001
≥ 40%	4 (4.6)	3 (4.3)	18 (22.5)	25	
Severe periodontitis					
No	81 (93.1)	64 (92.8)	65 (81.3)	210	0.03
Yes	6 (6.9)	5 (7.2)	15 (18.8)	26	
All values given as n (%).					

MATERIALS AND METHODS

The study was conducted according to The World Medical Association Declaration of Helsinki. It was approved by the Ethics and Research Committee of the Faculty of Dentistry, Federal University of Bahia (Protocol 235.069). Individuals who agreed to participate signed an informed consent form.

This cross-sectional study included adult individuals (≥ 18 years of age) consecutively seen in a private medical center in Salvador, Bahia, Brazil. The outcome was defined as severe periodontitis according to the CDC-AAP case classification: individuals with ≥2 proximal sites with CAL ≥6 mm not on the same tooth, and ≥1 proximal site with PD ≥5 mm.¹⁷ Obesity was considered the exposure factor. The subjects were classified as normal (BMI between 18.50 and 24.99), overweight (BMI between 25.00 and 29.99) and obese (BMI ≥ 30.00). BMI was calculated as the weight in kilograms divided by height in meters squared (kg/m²). Underweight individuals and those who required antibiotic prophylaxis prior to periodontal examination or had other systemic diseases considered to be risk factors for periodontal diseases (including diabetes) were excluded.

A representative sample of adults was calculated based on the prevalence of periodontal disease in normal-weight individuals (17%) and in obese individuals (54%),¹³ with a type I error rate of 0.01 and a power of 90%. The calculated sample was 114 (57 obese and 57 normal-weight individuals). However, during the months of data collection, 237 individuals were invited to participate. Only one individual declined. Therefore, 236 individuals, including 80 obese, 69 overweight and 87 normal-weight participants were in-

cluded. The groups were age- and sex-matched. There were no statistically significant differences between the groups in terms of demographics and socioeconomic status ($p \geq 0.11$) (Table 1).

Data Collection

The participants were examined between June 2013 and April 2014. Before the periodontal examination, in-person interviews were conducted by one researcher (TMS) to collect standard data on demographics, socioeconomic status, and other health-related data using a structured, written questionnaire. Anthropometric measurements including weight (kg) and height (m) were obtained by a single examiner.

One calibrated periodontist (TMS) assisted by one trained undergraduate student from the Dental School of the Federal University of Bahia performed all of the periodontal examinations. Before the study, the examiner was calibrated for accuracy and repeatability on a population of 10 patients not related to the study. The intraclass correlation coefficient (ICC) revealed intraexaminer reproducibility on the site level for probing depth (PD) (ICC = 0.85) and the distance between the cemento-enamel junction and the free gingival margin (CEJ-GM) (ICC = 0.92). Clinical attachment level (CAL) was calculated as the sum of the PD and CEJ-GM measurements (ICC = 0.86). Oral examination was performed using a headlamp (Turboled, Nautika; São Paulo, Brazil) with the participants seated on a regular chair in the private medical center.

All permanent, fully erupted teeth excluding third molars were examined using a manual periodontal probe (PCP-UNC

Table 2 Bivariate analysis of the association of putative periodontal risk factors with the occurrence of severe periodontitis (N = 236)

Variables	Periodontitis N (%)		Odds ratio (95% CI)	p-value
	No	Yes		
Gender				
Female	162 (77.1%)	22 (84.6%)	0.61 (0.20-1.86)	0.39
Male	48 (22.9%)	4 (15.4%)		
Age (years)				
18-34	116 (55.2%)	11 (42.3%)	1.68 (0.74-3.83)	0.21
≥ 35	94 (44.8%)	15 (57.7%)		
Education				
Up to high school	20 (9.5%)	8 (30.8%)	4.22 (1.63-10.94)	0.01
University degree	190 (90.5%)	18 (69.2%)		
Income (US\$)				
≤ 1288.78	107 (51.0)	19 (73.1)	2.61 (1.05-6.48)	0.33
> 1288.78	103 (49.0)	7 (26.9)		
Plaque index (%)				
< 40	192 (91.4%)	19 (73.1%)	3.93 (1.46-10.60)	0.004
≥ 40	18 (8.6%)	7 (26.9%)		
Obese				
No	145 (69%)	11 (42.3%)	3.04 (1.32-6.98)	0.007
Yes	65 (31%)	15 (57.7%)		
Overweight				
No	81 (55.9)	6 (54.5)	1.06 (0.31-3.61)	0.59
Yes	64 (44.1)	5(45.5)		

15, Hu-Friedy; Chicago, IL, USA). PD and CEJ-GM were measured at 6 sites per tooth (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual, and mesio-lingual). Measurements were made in mm and rounded to the next whole mm. CAL was calculated as the sum of the PD and CEJ-GM measurements and used for CDC-AAP case classification. The presence or absence of visible biofilm was evaluated at 6 sites per tooth in all present teeth except for the third molars.¹

Data Analysis

The statistical analysis included 236 individuals. Demographic information, socioeconomic status, and other health-related data were categorised. Age was categorised as 18–34 or ≥35 years. Education level was categorised as up to high school or university degree. Income level was categorised as ≤ US\$ 1288.78 or > 1288.78 per month, based on the median. Individuals were classified as current non-smokers or smokers. Plaque index was categorised as either > 40% or < 40%.

Chi-squared tests were used to compare obese, overweight and normal-weight participants and to compare individuals with and without severe periodontitis, according to conventional risk factors (age, sex, education, income and smoking status), overweight and obesity. Backward stepwise logistic regression was used to determine the set of variables that were associated with severe periodontitis.

Variables were entered into the regression model when $p \leq 0.1$ in the bivariate model. Therefore, education, income, plaque index, and obesity were entered into the regression model. The odds ratios (OR) and the 95% confidence intervals (CI) were calculated. The chosen level of significance was 5%. Data analysis was performed using a statistical software programme (SPSS v 13; Chicago, IL, USA).

RESULTS

Two hundred thirty-six individuals, including 80 obese, 69 overweight and 156 normal-weight participants were included.

Bivariate analyses showed that severe periodontitis was not significantly associated with overweight (OR = 1.06, 95% CI = 0.31–3.61, $p = 0.59$) (Table 2). However, bivariate analyses showed that severe periodontitis was significantly associated with obesity (OR = 3.04, 95% CI = 1.32–6.98, $p = 0.007$) as well as higher plaque index values (OR = 3.93, 95% CI = 1.46–10.60, $p = 0.004$) and education (OR = 4.22, 95% CI = 1.63–10.94, $p = 0.01$) (Table 2). After adjustment for covariates (education and plaque index), severe periodontitis was significantly associated with obesity (OR = 3.25, 95% CI = 1.27–8.31, $p = 0.01$)

Table 3 Logistic regression for the occurrence of severe periodontitis (N = 236)

Variables	Odds ratio (95% CI)	p
Education (years)		0.01
≤ 18	1	
19–31	4.37 (1.53-12.47)	
Obese		0.01
No	1	
Yes	3.25 (1.27-8.31)	

and lower educational level (OR = 4.37, 95% CI = 1.53-12.47, $p = 0.01$) (Table 3).

DISCUSSION

In this study, the association between severe periodontitis and obesity degree was evaluated in a population from Northeast Brazil. The results showed that periodontitis was associated with obesity, but not with overweight.

A strong association was found between obesity and periodontitis in this study. The risk for severe periodontitis was 3 times higher in obese individuals. Different mechanisms may explain the association between these diseases. Adipose tissue secretes several pro-inflammatory cytokines and hormones that are involved in inflammatory processes of periodontitis, and may increase periodontal destruction.²⁰ The effect of obesity can also change the production and release of important defense cells, such as neutrophils, recognised as the first line of defense of the periodontal tissues, and T and B lymphocytes, responsible for cellular and humoral responses.¹⁸ Obesity is a state of low-grade chronic inflammation, which makes obese and overweight people more susceptible to infectious diseases than people of normal weight.¹⁰ However, it is possible that there is no causal relationship between body weight and periodontal infection. Obesity and periodontal diseases share the same risk factors, including poor lifestyle and diabetes,^{6,16,20} which may explain the existence of a link between them. It is also possible that any cause-and-effect relationship between periodontal diseases and obesity might be the reverse of what is commonly assumed, i.e. periodontal infection affects obesity.

In the present study, overweight was not associated with periodontitis. This may be associated with two facts. First, in the overweight individuals had a lower plaque index compared to obese participants (mean plaque index: overweight: 16.33 ± 14.15 ; obese: 27.07 ± 17.97 ; $p < 0.001$; t-test data not shown). It has been shown in animals that under healthy oral conditions, obesity per se does not pro-

mote pathologic periodontal alterations; however, in response to bacterial plaque accumulation, periodontal inflammation and destruction are more severe in obese animals. Second, a combination of risk factors is suggested as eliciting the most severe periodontal effects.² It is possible that overweight individuals of the present sample were not exposed to other risk factors, such as hypertension.

Periodontitis is a multifactorial disease modified by numerous risk factors, including the patient's age, socioeconomic status, level of biofilm control,⁴ as well as factors not present in the current sample, e.g. smoking habits and diabetes.⁶ The age, biofilm control and economic level were not associated with severe periodontitis in the multivariable analysis of the present sample. Otherwise, lower education level was associated with severe periodontitis, confirming the strong effect of social determinants and lifestyle on periodontal health status.¹⁹

The sample size might be a limitation of this study. Considering the financial constraints involved in the development of this study, a sampling error of 5% was employed and no correction factor was used for the sample size calculation. Furthermore, as the groups were age and sex matched and recruited from a single private medical center, the inclusion of more volunteers within the time available to this project was not possible. Although this study indicated an association between obesity and periodontal disease, the design of this study limits conclusions about causality. Prospective cohort studies may be useful for determining the cause-effect relationship between periodontitis and obesity. A third limitation of the study is the used of BMI. It provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, BMI should be considered a rough guide, because it may not correspond to the same degree of overweight in different individuals. In recent years, there is a growing debate on the needs for developing different BMI cut-off points for different ethnic groups due to the increasing evidence that the associations between BMI, percentage of body fat, and body fat distribution differ across populations.²⁹ Thus, health risks may possibly increase below the cut-off point of 30 kg/m².

CONCLUSION

Severe periodontitis was associated with obesity. Given the complex and multifactorial nature of obesity and periodontitis, it is recommended that affected patients be informed about the link between these two diseases. Other studies need to be conducted to elucidate whether there is causality involved in the relationship between periodontal disease and obesity. Better knowledge of the relationship between obesity and oral health will enable the development of guidelines and instructions for dental care and prevention in obese patients.

ACKNOWLEDGMENT

We thank Luis Claudio Cardoso and Juliane Fagundes for their collaboration during data collection.

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