The bidirectional relationship between obesity and periodontal disease – a narrative review

A relação bidirecional entre a obesidade e a doença periodontal – uma revisão narrativa

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ABSTRACT
Periodontal diseases (PD) are multifactorial, chronic and infectious-inflammatory diseases that destroy periodontal attachment tissues and bacterial biofilms. Obesity is a chronic, multifactorial disease in which there is an excessive accumulation of body fat that harms the health and well-being of an individual. Periodontal diseases are important in the context of general health since they may be linked to several systemic diseases, such as obesity. This article aims to highlight the bidirectional relationship between obesity and periodontal disease. Materials and methods: The bibliographic review covered the PubMed, LILACS, and SciELO databases, and comprised studies and articles about the possible correlation between obesity and periodontal diseases between 2017 and 2021. In this context, periodontal diseases and obesity are similarly chronic, multifactorial, inflammatory and complex diseases which may interact with each other. The biological mechanisms responsible for the pathophysiology between periodontal diseases and obesity have not been fully understood. Their possible correlation is based on the production of hormones and cytokines via adipose tissue, altering the inflammatory response and interfering with the immune system. The data from this review demonstrate a lack of clinical studies assessing the role of periodontal diseases as a risk factor and as aggravation of obesity. Moreover, these data may support clinical research in this context.

Keywords: body composition, obesity, overweight, periodontitis.

RESUMO
Doenças periodontais (PD) são doenças multifatoriais, crônicas e infecciosas-inflamatórias que destroem tecidos periodontais de apego e biofilmes bacterianos. A obesidade é uma doença crônica, multifatorial, em que há uma acumulação excessiva de gordura corporal que prejudica a saúde e o bem-estar de um indivíduo. As doenças periodontais são importantes no contexto da saúde geral, uma vez que podem estar ligadas a várias doenças sistêmicas, como a obesidade.

Este artigo visa destacar a relação bidirecional entre obesidade e doença periodontal. Materiais e métodos: A revisão bibliográfica abrangeu as bases de dados PubMed, LILACS e SciELO, e incluiu estudos e artigos sobre a possível correlação entre obesidade e doenças periodontais entre 2017 e 2021. Neste contexto, as doenças periodontais e a obesidade são igualmente crônicas, multifatoriais, inflamatórias e complexas que podem interagir entre si. Os mecanismos biológicos responsáveis pela fisiopatologia entre as doenças periodontais e a obesidade ainda não foram totalmente compreendidos. Sua possível correlação se baseia na produção de hormônios e citocinas via tecido adiposo, alterando a resposta inflamatória e interferindo no sistema imunológico. Os dados dessa revisão demonstram a falta de estudos clínicos que avaliem o papel das doenças periodontais como fator de risco e agravamento da obesidade. Além disso, estes dados podem apoiar a investigação clínica neste contexto.

Palavras-chave: composição corporal, obesidade, sobrepeso, periodontite.

1 INTRODUCTION

Periodontal diseases (PD) are infectious-inflammatory diseases caused by the bacterial biofilm acting on a susceptible host. This bacterial biofilm triggers the destruction of the attachment tissues.[1] However, if the periodontal disease is discovered in the initial phase, it can be successfully treated with no major morbidities.[2] Approximately 20% to 60% of the world's population may have some degree of periodontal disease[3], the onset and progression of wich may be caused by biological, environmental and behavioral factors.

The intake of macronutrients, combined with poor physical functioning, may be linked to the progression of a wide range of inflammatory diseases[4], either by direct modulation of the immune response of the host, or via the microbiome. Therefore, this also includes periodontitis.[5]

The pathogenesis of periodontitis is multifactorial, with environmental, microbial and host involvement, thus affecting disease outcomes. Many systemic conditions have been associated with periodontitis, including rheumatoid arthritis, diabetes mellitus, arterial hypertension, heart disease, chronic lung diseases and metabolic syndrome (MS).[4,6,7,8,9,10]

MS is a group of concomitant conditions that increase the risk of cardiovascular disease and double the risk of type 2 diabetes. There are several definitions of metabolic syndrome, and they differ slightly depending on the issuing institution. The National Cholesterol Education Program Adult Treatment Panel III provides the most commonly used definition. Such definition requires that individuals have at least three of the following risk factors: (a) large waist circumference, (b) low plasma levels of high-density lipoprotein cholesterol, (c) elevated plasma triglycerides, (d) high blood pressure, and (e) high blood glucose levels[11]. In addition, epidemiological evidence from the last two decades has showed an increase in periodontitis in

obese and overweight individuals. Such factors were associated with periodontitis because obesity has some effects on the systemic health, providing a greater susceptibility of the host to periodontitis, through inflammatory mediators, altered immune response, specific genetic polymorphisms and stress accentuation.[12]

Data from the National Health Survey (PNS/2019) indicate that, currently in Brazil, 60.3% of adults are overweight, the equivalent to ninety-six million people, of which 62.6% are women. Obesity, including overweight individuals, affects 25.9% of the population - about 41.2 million adults, also with a higher prevalence among women (29.5%) than among men (21.8%).[13]

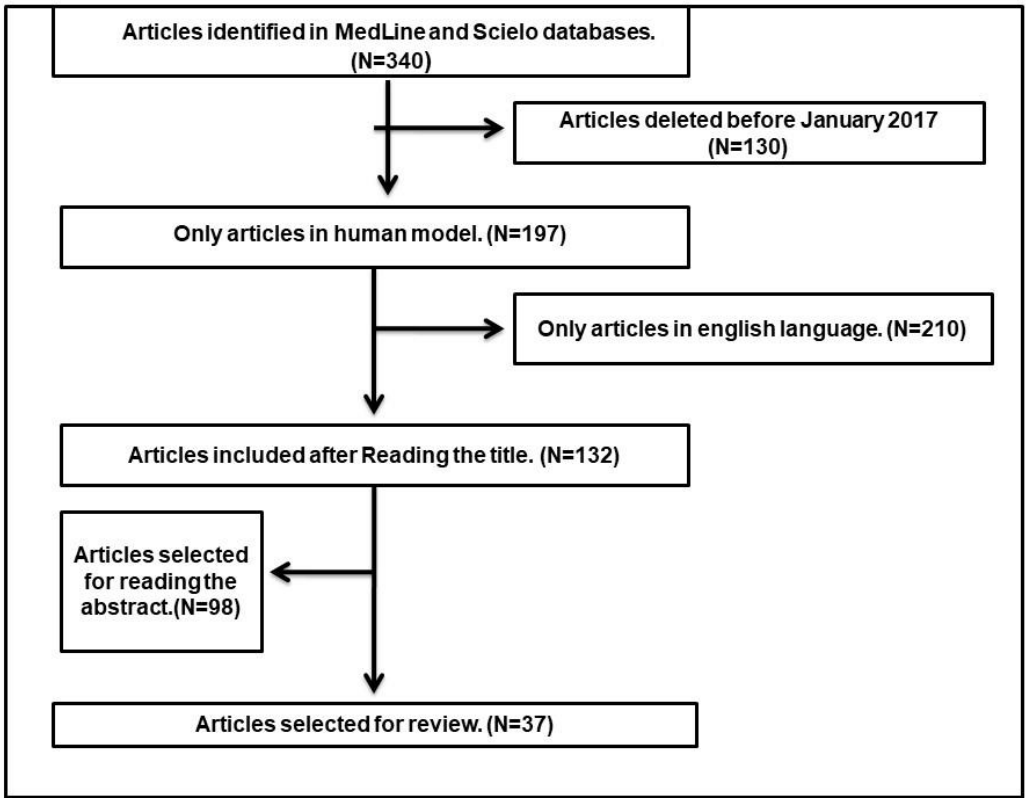
With regard to periodontitis and metabolic syndrome to date, most studies point to an association between these two conditions and demonstrate that periodontitis may contribute to or worsen the metabolic syndrome, mainly, obesity[22, 12]. However, due to the lack of longitudinal intervention studies and randomized controlled trials, the magnitude is unclear to determine the cause-effect relationship between these two diseases.[14,15]

In this context, the present study focuses on the association between periodontitis and obesity, aiming to identify and discuss them. The findings from this research may establish a solid base to improve future research and interventions in this health-disease context.

2 METHODS

This study is a narrative review of descriptive character regarding the association of periodontitis with obesity and it is appropriate to discuss the state of the art of a certain subject. This bibliographic survey was done in the LILACS, SciELO and PubMed database systems in September 2021. In addition, the Ministry of Health database was assessed. The reference period is four years. The index terms or descriptors Body composition, obesity, overweight, periodontitis and their respective Portuguese translations were used, either isolated or in combination, with no specific time interval.

Table 1: Flowchart



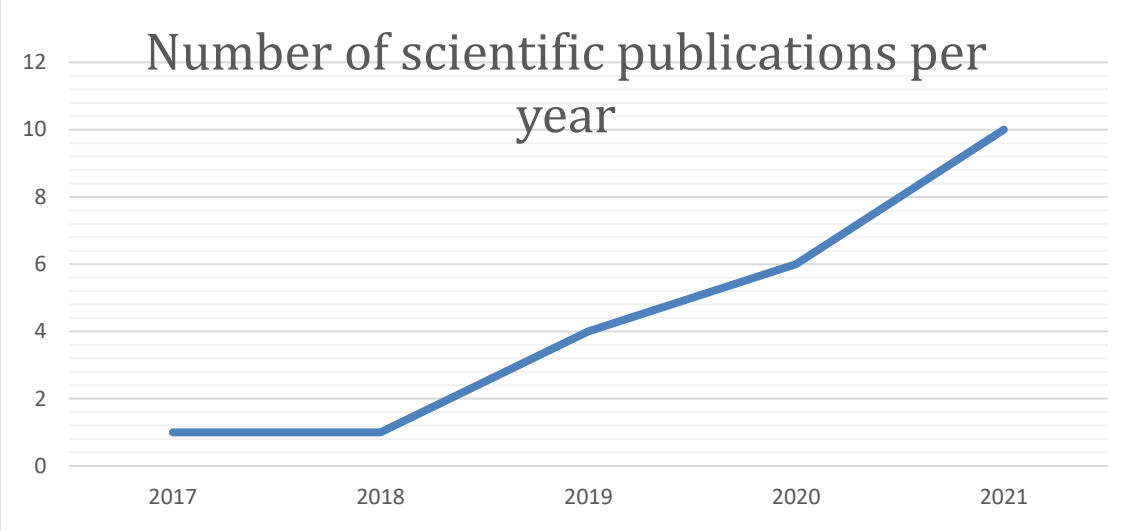
3 RESULTS

Having the index terms in the title or as keywords was the criterion used to select the articles. Another criterion was having explicit in the abstract that the text is related to periodontitis and obesity. In addition, articles in Portuguese and in English, systematic reviews or meta-analysis of all randomized and non-randomized controlled trials, case-control studies, and cohort studies published in journals were selected. Some articles were not selected because they did not have well-established inclusion criteria. Some were poorly designed and had unclear methodologies. Others had authority opinions, reports from expert committees and editorials. Non-original dissertations and studies were also excluded.

Subsequently, the previously chosen articles were analyzed in full to confirm eligibility. Other studies were also excluded because they evaluated the association of periodontal disease with other systemic diseases, such as Alzheimer's, asthma, cancer, diabetes, liver disease, chronic kidney disease, helicobacter pylori, rheumatoid arthritis, psoriasis and allergic rhinitis.

Upon reading the abstracts, 242 articles were excluded due to the research criteria. After reading the full text, 61 articles were excluded, totaling a final sample of 37 articles for a complete analysis. As shown in graph 1, specifically with regard to the 24 selected articles, the number of studies published per year varies from 2017 to 2021.

Graph 1: Number of scientific publications about the association of periodontitis and obesity from 2017 to 2021.



The studies have been biased and controversial. This fact possibly reflects the difficulty in establishing a systematic method to gather existing research related to the topic, since these publications are scarce in the scientific literature.

4 DISCUSSION

So far, cross-sectional and longitudinal studies have been conducted, as well as some meta-analyses, which assess the relationship between these two conditions that are so prevalent[7,8,23,24,25,27,30,32]. The vast majority of data demonstrate a strong association between obesity and periodontitis. [16,17, 20, 22, 23, 24, 25, 26, 28, 29, 35]. The Table 1 detailed the articles considere.

In the case-control study performed by Campos et al, a high prevalence of periodontitis was observed among the case sample (54.6%), when compared to the control sample (45.4%). The significant variables associated with the occurrence of periodontitis in the final logistic model were that of MS (odds ratio [OR] = 2.02; P = 0.003). These variables report an important risk association with periodontitis. Individuals with MS have worse periodontal status and greater prevalence, severity and extent of periodontitis[16]. In addition, the study conducted by Suzuki et al obtained an odds ratio of 2.40, a 95% confidence interval (1.11-5.22), showing that obesity, determined according to a visceral fat index, was associated with bleeding on probing.[17]

The influence of Body Mass Index (BMI) on the progression of periodontitis

In the cohort study performed by Suvan et al, it was shown that obesity compared to normal BMI was an independent predictor of worse response after nonsurgical periodontal therapy ($p<0.01$). Thus, overweight/obese individuals are more likely to suffer from periodontitis compared to normal weight individuals in the control sample. [24]In general, obese

individuals with periodontitis can significantly benefit from nonsurgical periodontal treatment, which reduces several biochemical biomarkers of obesity with or without weight loss[37]. However, in a systematic review by Silva et al, meta-analyses were analyzed for measures of gingival inflammation compared to BMI. Most studies showed no significant difference in gingival inflammation measurements regardless of the comparison performed. However, the meta-analysis showed that among individuals with periodontitis, those with obesity have significantly higher levels of gingival inflammation (no. of individuals = 240) than those who were not obese (no. of individuals = 574) (SMD: 0.26; 95% CI: 0.07–0.44).[32]

Association between the inflammatory response of obesity and periodontitis.

Lipoinflammation is a relatively new word and recent studies have associated it with nonalcoholic fatty liver disease (NAFLD)[34]. The systemic pathological condition is linked to inflammation as cardiovascular disease. The correlation is bidirectional once periodontal disease is present. The local infection burden and inflammation stimulate the hepatic response through increased dissemination of bacteria and their products along with cytokines and reactive oxygen species[35]. Nicolin et al elucidated the roles played by lipoinflammation and obesity in biochemical traffic in inflamed periodontal tissues with an interaction between both diseases. Such links can affect the clinical manifestation, progression and prognosis of periodontal diseases.[20] As Suvan et al, at the beginning of the study, Nicolin et al also showed that periodontal parameters were worse in obese than in non-obese individuals. During nonsurgical periodontal therapy, inflammatory mediators in these patients were considerably controlled with a strong association between them. [23]

In the Brazilian population-based cohort study by Nascimento et al, the total-effect model showed that those with general obesity, in the cohort period, had a higher risk of unfavorable periodontal outcomes (rate ratio [RR]: 1.45 for AL and BOP in different teeth; RR: 1.84 for AL and BOP in the same tooth). [25]

In research conducted by Gul et al, the obesity status and the severity of periodontitis showed a statistically significant association ($p = 0.017$). Therefore, overweight and obese individuals have more severe periodontitis than normal weight individuals in an Iraqi population sample. [26]

Age group as a predictive factor for the association between obesity and periodontitis.

Torrejon-Moya, in her descriptive observational study, did not obtain a conclusive result about the association of a hypercaloric diet with periodontal disease because the study is composed of an extremely young population. As a conclusion, the study suggested that because

of their early age, they tend to have a healthier diet and do more physical activities. Moreover, there is a lower incidence of periodontitis, which increases with age.[28]

Aging is associated with the development of diseases. Multisystem conditions, such as frailty, play a key role in health in older populations. Frailty is a clinical condition in older patients and it increases the risk of adverse health outcomes. Both frailty and periodontal disease are common chronic conditions in older populations and have in common several risk factors[36]. Teixeira et al observed significant differences, mainly for the degree of severe periodontitis between young adults and older adults. The first group had a significantly higher prevalence of obesity, pre-diabetes, hypertension and metabolic syndrome. The second group had a significantly higher prevalence of obesity, dyslipidemia, prediabetes, hypertension, subclinical atherosclerosis, and metabolic syndrome. Individuals with mild/moderate periodontitis also had significantly higher levels of dyslipidemia, subclinical atherosclerosis, and metabolic syndrome, with BMI significantly higher among participants with periodontitis.[29] The cohort study performed by Suvan et al also showed that obesity was an independent predictor of worse response after nonsurgical periodontal therapy ($p<0.01$).[35]

Although the vast majority of studies conclude that there is an association between metabolic syndrome and periodontitis, other studies have found weak associations or no association between these two conditions.[27,29,30,31,32,33].

Charupinijkul et al, for example, performed a retrospective cohort study in which univariate analysis indicated that overweight individuals had a 15% higher risk of progression than healthy individuals. However, when confounding factors were analyzed simultaneously, the effect of obesity was not significant, with a risk ratio of 0.98, demonstrating that obesity is not an independent risk factor for the progression of periodontitis. However, the sample group was very small. [27]

The type of diet was included in the study by Teixeira et al because it is an important characteristic of groups of patients with metabolic diseases. However, no significant associations were found with periodontal attachment loss or periodontitis, although tooth loss was lower in vegetarians ($p < 0.05$), possibly due to other characteristics of the diet in this group, such as lower consumption of cariogenic food and a highly nutritional diet. [29]

Hypertension and diabetes were the most prevalent comorbidities with 23.4% and 16%, respectively. In the cross-sectional study conducted by Alsalihi et al, in overweight individuals, 97% of the participants had periodontitis. However, BMI was not correlated with periodontitis, but waist circumference had a weak positive correlation.[30] Yilmaz and Somay also showed in a study that periodontitis was detected at a higher rate in the obesity group (58%) compared to

the control group, but the relationship between obesity and periodontal status was not statistically significant. [31]

The influence of gender on the periodontal condition associated with obesity has not been very clear yet, and definitive conclusions cannot be drawn. A pilot study revealed that periodontitis may be more prevalent in females[18,19]. In contrast, other studies reveal that periodontitis was more prevalent and severe in males[17,22]. However, this may be more related to behavioral factors than genetic factors, as men generally take less care of their oral health and do not go to the dentist as often as women.

The Figure 1 illustrates the bidirectional relationship between obesity and periodontal disease

Figure 1: Bidirectional relationship between obesity and periodontal disease according to body changes.

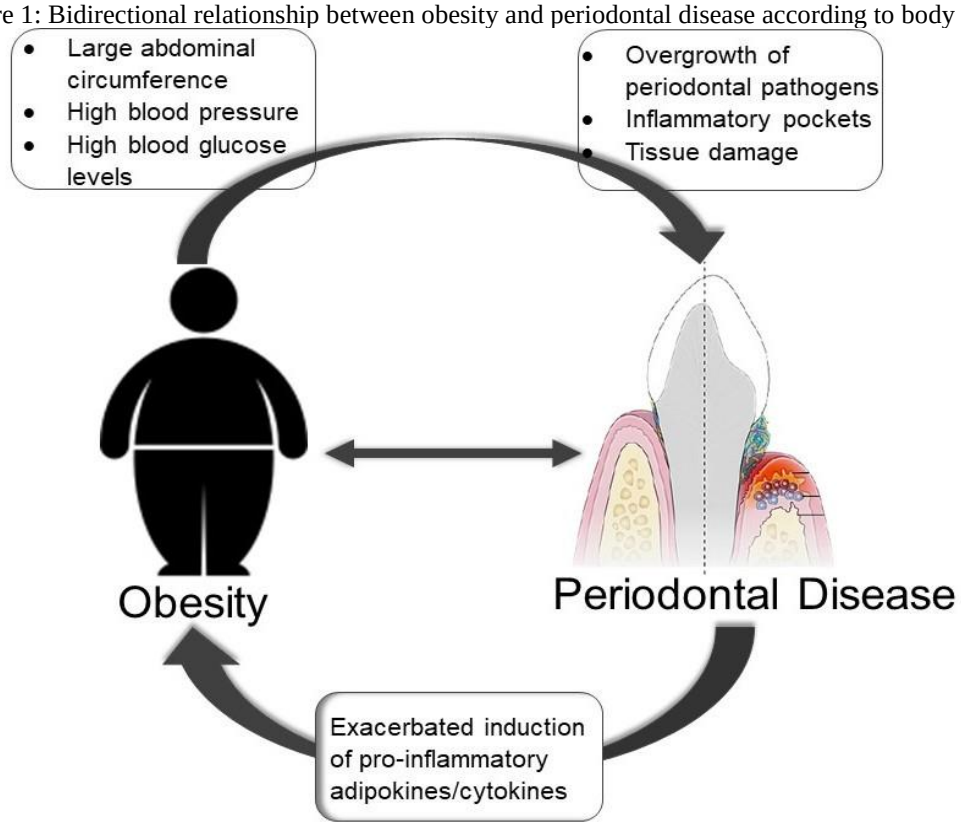


Table 2: Articles considered according to author/year, title, sample size and result.

Author/Year	Title	Sample (n)	Results
Campos et al., 2019[16]	Association between periodontitis and metabolic syndrome: a case-control study	N=488	There was a strong association between periodontitis and metabolic syndrome.
Suzuki et al., 2020[17]	Relationship between obesity indicators and gingival inflammation in middle-aged Japanese men	N=159	There was an association between obesity and bleeding on probing score.

Cioquetta et al., 2020[18]	Gender differences in the association between obesity and gingivitis in 12-year-old South Brazilian schoolchildren	N=1528	There was a strong association between obesity and gingivitis. (P<0,001)
Thomas et al., 2020[19]	Obesity generates a signature of the oral microbiota of female patients with periodontitis: a pilot study	N=19	There was a strong association between obesity and periodontitis in female patients.
Nicolin et al., 2020[20]	Can periodontal disease be linked to obesity and lipoinflammation? Mechanisms involved in the occurrence of pathogenesis	Revision	There was an association between periodontal disease, obesity and lipoinflammation.
Teixeira et al., 2020[21]	Relationship between periodontitis and subclinical risk indicators for chronic noncommunicable diseases	N=420	There was a strong association between BMI and periodontitis.
Suvan et al., 2020[23]	Effect of periodontitis treatment on the incretin axis in obese and non-obese individuals: a cohort study.	N=115	There was an association between obesity and periodontal disease.
Suvan et al., 2020[24]	Obesity as a predictor of clinical outcomes of periodontal therapy: a cohort study	N=115	There was an association between periodontal disease and obesity.
Nascimento et al., 2017[25]	Obesity and periodontal outcomes: a population-based cohort study in Brazil	N=1066	There was an association between periodontal disease and obesity.
Gul et al., 2021[26]	Association of overweight/obesity with periodontitis severity using the BPE code in an Iraqi population	N=58	There was a strong association between severe periodontitis and overweight and obesity.
Charupinijkul et al., 2021[27]	The effect of obesity on periodontitis progression: the 10-year retrospective cohort study	N=2216	There was no association between obesity and periodontitis progression.
Torrejon-Moya et al., 2021[28]	Analysis of healthy lifestyle habits and oral health in a sample of patients from the Dental Hospital of the University of Barcelona.	N=230	It was not possible to conclude an association between healthy habits related to better oral quality.
Teixeira et al., 2019[29]	Periodontal attachment loss and associations with sociodemographic and behavioral risk indicators	N=420	There was an association between the development of periodontal diseases in patients with chronic diseases.
Alsihi et al., 2021[30]	Prevalence of periodontitis in obese patients in Bahrain: a cross-sectional study	N=372	There was no association between periodontal disease and obesity.

Yilmaz e Somay, 2021[31]	Is obesity a problem that threatens oral health in adults?	N=200	There was an association between periodontitis and obesity, but it was not statistically significant.
Silva et al., 2021[32]	Association between clinical measures of gingival inflammation and obesity in adults: systematic review and meta-analyses	N=547	Significantly greater measures of gingival inflammation were observed in the groups with the highest BMI.

5 FINAL CONSIDERATIONS

Additional prospective studies are necessary to quantify or understand the mechanisms of this association. Despite this, scientific evidence points to a negative impact of obesity on oral health. On the other hand, there are very few studies that assess whether there is a greater tendency to develop obesity in patients with periodontitis. In addition, several logistical and physiological impasses are related to the therapeutic intervention of obese patients in a dental environment, indicating the need for an interdisciplinary approach. In this way, it is crucial to make the general population and the health team aware of the possible bidirectional implications between PD and Obesity, two conditions that are increasingly prevalent. Preventive action, through the dissemination of knowledge, in both conditions, may have a direct impact on the oral and general health of the population.

CONFLICT OF INTEREST

None to declare.

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