Review Article

IS OBESITY A RISK FACTOR FOR PERIODONTAL DISEASE? AN INTEGRATIVE LITERATURE REVIEW

ABSTRACT

Aims: Periodontal disease (PD) is a chronic inflammatory pathology that arises from the interaction between pathogenic bacteria and the host's immune response. The literature addresses associations of PD with other systemic conditions, such as obesity (BO). The objective of this study was to review the literature looking for scientific evidence that could clarify whether BO would be a risk factor for PD.
Study design: An integrative literature review.
Methodology: We searched for articles on the VHL Regional Portal (Virtual Health Library) published in English, Spanish and Portuguese between 2019 and 2024. 79 articles were found. Of this total, 63 were excluded, 1 due to duplication and 62 for not meeting the inclusion criteria.
Results: The results revealed four hypotheses: a) Body mass index and waist circumference are strongly associated with an increased prevalence of PD; b) Overweight, OB and visceral adiposity index are among the main risk factors for the development of PD and the increase in its prevalence; c) PD occurs independently of metabolic syndrome (OB and overweight) and the association between PD and OB may not be so significant, even though OB presents a 15% higher risk of progression to PD; d) Although severe PD was significantly associated with OB, it was not associated with overweight.
Conclusion: Therefore, most studies report a relationship between OB and PD, showing that OB plays a role in the systemic inflammation process and that it can indirectly accelerate the onset and progression of PD.

Keywords: Periodontal disease. Obesity. Risk factor.

1. INTRODUCTION

The concept of obesity, according to the World Health Organization (WHO), is characterized by a condition of excessive accumulation of body fat to a certain degree, in which the health and well-being of individuals can be detrimentally affected [1]. Obesity, which presents itself as a chronic condition that develops, appears to be the result of several isolated or interacting factors. Among its possible causes, neurological, endocrine, genetic, pharmacological, physical inactivity, environmental factors, lifestyle, and psychological factors stand out [2]. Recently, caring for people with obesity has been considered a major

challenge due to its complexity and magnitude. Data from the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel) revealed that, in the 27 Brazilian capitals, the frequencies of overweight and obesity were 57.2% and 22.4%, respectively, in 2021 [3].

The increase in its incidence is distributed across almost all races and genders, and mainly affects the population aged 25 to 44 [4]. Today, 56% of Brazilian adults are obese or overweight (34% with obesity and 22% with overweight). It is estimated that, if current trends continue, in 20 years, 130 million Brazilian adults will be overweight or obese (83 million with obesity and 47 million with overweight). Currently, 24.3% of Brazilian adults are considered obese – a percentage that reaches 32.6% among men aged 45 to 54, practically 1 in 3. On the other hand, the lowest proportion is among women aged 18 to 24, in which 11.8%, 1 in 10, are obese [5]. Furthermore, there is a consensus that the etiology of obesity is quite complex, presenting a multifactorial character [6]. However, research focuses on issues related to the greater energy intake of the diet and the reduction in physical activity with the incorporation of a sedentary lifestyle, configuring the so-called contemporary Western lifestyle [7].

Furthermore, periodontitis, a chronic inflammatory disease, arises from the interaction of pathogenic bacteria and the host immune response, which gradually erodes the periodontal supporting structure and ultimately results in tooth loss [8]. Worldwide, periodontitis affects approximately 45–50% of the population, with severe cases impacting 11.2%, ranking it as the sixth most common disease in the world [9]. Periodontitis is highly prevalent in adults over 30 years of age in the US, according to the National Health and Nutrition Examination Survey (NHANES, 2009–2014) [10]. Its social burden is increasing globally, warranting global changes in public health policies [11]. Inflammatory periodontal disease can present several stages, with different patterns of evolution and clinical manifestations, however, always having dental biofilm as the main etiological factor, and being modulated by the different responses that the susceptible host may present [12].

Studies have shown that obese individuals have a 35% higher risk of developing periodontitis compared to normal-weight individuals, and this condition may be higher among obese women when compared to obese men [13, 14]. Among the periodontal changes associated with increased body mass index (BMI) as a risk factor are gingival bleeding and increased probing depth, which have been highlighted as characteristics of tissue inflammation related to obesity [15]. For every 1 cm increase in abdominal circumference (AC), there is a 5% increase in the risk of developing periodontitis. Thus, an increase in abdominal circumference can be considered a characteristic that increases the likelihood of developing Periodontal Disease (PD). Furthermore, obesity negatively affects the patient's immune system, as large amounts of adipose tissue cause an increase in the secretion of several pro-inflammatory cytokines, thus increasing the inflammatory levels of PD [16].

Therefore, it is essential that the dentist knows the relationship between obesity and the comorbidities caused by it that are directly related to dental problems, so that a better diagnosis and treatment prognosis can be established for the patient in an integral way and considering the entire context in which he/she is inserted, which will directly affect his/her quality of life. The objective of this study was to evaluate the influence of obesity on periodontal diseases, through an integrative literature review. The aim is to identify, analyze and discuss the ways in which obesity can exacerbate the periodontal disease condition.

2. METHODOLOGY

This is an integrative literature review study evaluating obesity as a risk factor for Periodontal Disease. The online bibliographic survey was carried out through the Regional Portal of the BVS (Virtual Health Library) (https://pesquisa.bvsalud.org/), a free access electronic database.

The choice of this research method or strategy for preparing this literature review was made with the aim of synthesizing the findings of several studies selected from different methodologies already published, analyzing the knowledge already constructed on a specific topic, using a rigorous method of searching and selecting research. As well as predefined and well-exemplified steps, in order to obtain among its objectives the review of theories, analysis of methodological problems of a given topic, definition of concepts and, finally, evidence. Simultaneously, the latter, it is the objective of this review to seek evidence on the relationship of obesity as a risk factor for periodontal disease [17].

The following keywords were used: “Obesity”, “Periodontal disease” and “Risk factor”. The advanced search strategy was performed with the following descriptors: “obesity” AND “periodontal disease” AND “risk factors”. These terms could be in the title, abstract or main subject of the different articles.

First, studies were selected by title, excluding those that were clearly not related to the topic of the review. Only recent articles that addressed the relationship or association between obesity and periodontal disease, both in humans and animals, with text written in English, Spanish and Portuguese, published between 2019 and 2024, were used as inclusion criteria in this research. Opinion articles that did not clearly report the relationship between obesity and periodontal disease as a risk factor for periodontal disease were excluded from this review, as well as research that was not available for reading in full in open access.

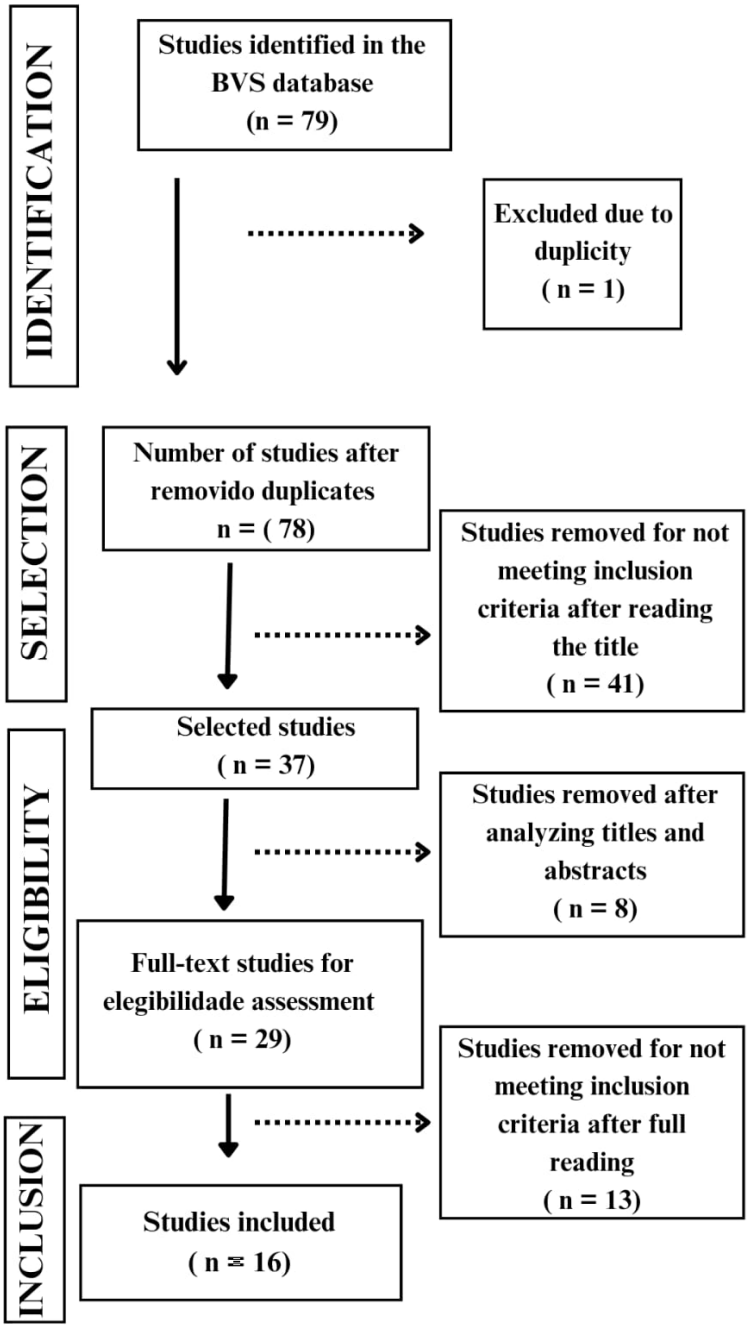
After the search mechanism was performed and the articles were identified, the studies were selected according to the guiding questions and inclusion criteria previously defined. All studies identified through the search strategy were initially evaluated by analyzing the titles and abstracts. In cases where the titles and abstracts were not sufficient to define the initial selection analysis, the study was then read in full.

The integrative review process followed the sequence of steps proposed by Botelho et al., (2011), consisting of six steps, namely: (1) identification of the theme and selection of the research question; (2) establishment of inclusion and exclusion criteria; (3) identification of pre-selected and selected studies; (4) categorization of selected studies; (5) analysis and interpretation of results; and (6) presentation of the review/knowledge synthesis. Figure 1 graphically shows an overview of the integrative review selection process.

3. RESULTS

This section contains the main results of the studies selected in this integrative review, according to the synthesis matrix (Table 2). As previously described, 79 articles were identified in this research conducted in the VHL Regional Portal database. Of this total, one duplicate study was excluded, and 78 articles (title) were analyzed. Of these, 41 were removed based on the title not meeting the inclusion criteria. Consequently, of the remaining 37 articles, 8 were removed after analysis of the titles and abstracts. Thus, 29 studies underwent eligibility assessment, through the complete reading of the studies, and thus, 13 studies were removed. In total, 16 studies were included (Figure 1).

Figure 1 - Flowchart of methodological steps.



Source: Prepared by the authors (2024).

Table 1 - Summary matrix used in this integrative review.

N	Author/Year	Objective	Methodology	Main findings

18	Lihan Xu *et al*. (2024)	To examine the association between the Weight Adjusted Waist Circumference Index (WWI) and the prevalence of periodontitis, providing new evidence on the link between central obesity and periodontal health.	Cross-sectional study	High levels of weight-adjusted waist circumference (WHC) are significantly associated with an increased prevalence of periodontitis. Current findings emphasize the importance of WWI levels in the assessment of periodontitis, particularly among the non-elderly population, where it may offer greater benefits. There is a suggestion of a strong correlation between central obesity and periodontitis. Among individuals aged between 30 and 60, the strength of this positive correlation is more pronounced than among those aged 60 and over.
19	Ling Liu *et al*. (2023)	To better understand the relationship between obesity and periodontal disease based on body mass index (BMI) and waist circumference (WC).	Cross-sectional study	BMI and WC are significantly associated with periodontitis, even after adjusting for many variables, and were equally significant in young people.
20	Silas Alves-Costa*et al*. (2023)	To analyze the relationship between periodontitis and behavioral and metabolic risks common to untreated chronic diseases (NCDs) in Brazilian adults over three decades.	Cross-sectional study	Data obtained from the Global Burden of Disease Study 2019 (GBD) showed that periodontitis has increased in Brazil since 2005, despite the reduction in smoking. Drinking sugary drinks was the behavioral risk that most closely followed the periodontal trend. Overweight and obesity are among the main behavioral risks for the periodontal trend.
21	Valéria Ramírez *et al*. (2023)	To evaluate the relationship between obesity and the stage of periodontitis compared to healthy periodontium or	Cross-sectional study	In addition to the already known risk indicators for periodontitis (age, smoking and schooling), our study suggests a relationship between obesity and the stage of periodontitis in

		gingivitis in pregnant women between 11 and 14 weeks of gestation.		pregnancy. Obesity can alter the host's immune responses, leading to increased susceptibility to infections and overactive host immunity, which can influence the prevalence and severity of maternal periodontitis during pregnancy.
22	Astrid Nilsen *et al*. (2023)	To explore the association between obesity-related variables and periodontitis, and to assess whether Metabolic Syndrome (MS) is a risk indicator for periodontitis in a sample of obese adults.	Cross-sectional study	In the present sample of obese individuals, periodontitis occurred independently of MetS. At a certain BMI level, the suggested association between MetS and periodontitis may not be significant due to the dominant impact of obesity-related variables, undermining the effect of other systemic factors.
23	Qinghua Yang et al (2023)	To investigate the association between visceral adiposity index (VIA) and periodontitis in 4,482 individuals.	Cross-sectional study	IAV is significantly associated with the risk of periodontitis in adults aged 40 to 50. The relationship between IAV and the risk of periodontitis in this age group is not linear. However, as this was a cross-sectional study, it was not possible to confirm a causal relationship.

24	Gadah Abu-Shawish et al. (2022)	To explore the possibility of significant evidence on the association between obesity and periodontitis and to determine the need to consider obesity as a risk factor for periodontitis.	Systematic review	A positive association has been found between obesity in terms of increased BMI and periodontitis in adults. The studies showed an association between an increased BMI and periodontal parameters such as clinical attachment level and pocket depth. Some studies also showed an increased risk of periodontitis in obese adults who were smokers. Based on the evidence obtained in this review, BMI should be routinely assessed in patients to offer personalized treatment of periodontitis, we recommend the need to sensitize physicians and implement preventive dental hygiene care measures for obese patients.
25	Daline Oliveira Carneiro et al. (2022)	To investigate the association between overweight and periodontitis in 345 adult individuals in the city of Salvador, Bahia, Brazil. Stratifying by gender and age, and using different criteria for obesity.	Cross-sectional study	Periodontitis was found in 74.2% of individuals, with the disease being more prevalent among those with an increased waist circumference. Obesity was positively associated with periodontitis in women and younger individuals, demonstrating that those with obesity are more likely to have periodontitis. Periodontal assessment and clinical management of obese individuals is recommended.
26	Dejana Čolak *et al*. (2022)	To evaluate the periodontal status of morbidly obese patients eligible for bariatric surgery and the association between	Cross-sectional study	Morbidly obese patients eligible for bariatric surgery have a high prevalence of periodontitis and are therefore advised to be examined by a dentist before

		periodontitis, obesity-related comorbidities and the Edmonton Obesity Staging System (EOSS).		undergoing surgery. The medical team should make obese patients aware of the possible association between periodontal health problems and hypertension.
27	ApinunCharupinijkul *et al*. (2022)	To estimate the effect of obesity on the progression of periodontal disease (PD) in Thai adults.	Cohort study	A retrospective study was carried out and found that the cumulative incidence of periodontitis progression over the 10-year period was 59.6 cases per 100 people. Univariate analysis indicated that obese individuals had a 15% higher risk of PD progression than healthy individuals. Obesity and PD progression share many common risk factors. Using obesity as a preliminary screening for periodontitis progression could be an alternative prevention protocol.
28	Carlos Fernando de Almeida Barros Mourão et al. (2021)	To assess the relationship between obesity and periodontal disease and the risk of chronic non-communicable diseases.	Cohort study	The incidence of periodontal disease progression over ten years was 59.6 cases per 100 people. Univariate analysis revealed that being obese was associated with a 15% higher risk of periodontal disease progression than in non-obese individuals. Despite the higher prevalence of periodontal disease among obese individuals, it is not considered an independent risk factor for the development of periodontitis.

29	Sukirth M. Ganesan (2021)	To evaluate the relationship between obesity and periodontal disease	Review article	Epidemiological evidence from the last two decades has established an increase in the prevalence of periodontitis in overweight and obese individuals. The biological mechanisms that potentially link obesity and periodontal disease are adiposity-associated hyperinflammation, microbial dysbiosis, altered immune response, specific genetic polymorphisms and increased stress.
30	Leena Alsalihi *et al*. (2021)	To assess the prevalence of periodontitis in overweight/obese adults attending the Ministry of Health (MOH) Nutrition Clinics in Bahrain, Persian Gulf, and to determine the factors associated with periodontitis in these obese adults.	Cross-sectional study	Periodontitis was present in 361 (97%) of the participants. The prevalence of periodontitis was high in this sample of overweight Bahrainis. BMI did not correlate with periodontitis, but waist circumference had a weak positive correlation. It is recommended to implement periodontal health screening as a routine part of a nutritional clinic program.
31	ChaeritaMaulani et al. (2022)	To investigate the correlation between obesity and periodontitis, among other risk factors for periodontitis.	Cross-sectional study	The prevalence of obesity was 48.47%. There were positive correlations between BMI and periodontal status for healthy-mild, moderate and severe periodontitis. Obesity by BMI measurement ≥ 25kg/m2 correlated with a higher risk of acquiring periodontitis compared to normal weight individuals.

32	Dalia Abril Guzmán-Gasteum*et al*. (2020)	To measure the association of obese patients with the development of periodontitis, as well as oral hygiene habits.	Case study control	Obese patients had a higher risk of developing low frequencies of daily oral brushing (70.8%) and, consequently, an increased presence of periodontal disease compared to non-obese individuals. It is possible that obesity acts as a factor that facilitates the presence of periodontitis due to deficiencies in daily tooth brushing.
33	Santos,Taise*et al*. (2019)	To evaluate the association of severe periodontitis with overweight and obesity.	Cross-sectional study	Although severe periodontitis was significantly associated with obesity, it was not associated with being overweight. Patients diagnosed with obesity should be referred for periodontal assessment.

WWI= waist circumference adjusted for weight; BMI= body mass index; WC= waist circumference; CNCD= chronic non-communicable diseases; MS= metabolic syndrome; VIA= visceral adiposity index.

Source: Prepared by the authors (2024)

4. DISCUSSION

This section followed the stage called “analysis and interpretation of results”, which corresponds to the fifth stage proposed by Botelho et al. (2011), which aims to analyze the relationship between obesity and periodontal disease. Of the 16 studies included in this review, most were written in English [18 - 31, 33], followed by Spanish [32].Most of the studies were cross-sectional [18,19,20,21,22,23,25,26,30,31,33]. Followed by review studies [24, 29] and cohort studies [27,28], and case-control studies [32]. Unanimously, the results of the studies analyzed in this research point to evidence regarding the existence of an association between obesity as a risk factor for periodontal disease, with the main factor being the Body Mass Index and Waist Circumference, indicating a strong relationship between these values, obesity and periodontal disease. Still based on the studies analyzed, four aspects of the results are observed, as described below:

. Body mass index and waist circumference are strongly associated with an increased prevalence of periodontitis, showing a strong correlation between central obesity/overweight and periodontal disease [18,19,24,25,26,29,30,31].

A. Tobacco and sugar were the behavioral risks that most closely followed the trend of periodontal disease (PD), in addition, overweight, obesity and the visceral adiposity index are among the main risk factors for the development of PD and the increase in its prevalence [20,21,23,27,32].
B. Periodontal disease occurs independently of metabolic syndrome (obesity and overweight) and the association between PD and obesity may not be so significant, although obesity presents a 15% higher risk of progression to periodontal disease, concluding that obesity cannot be considered an independent risk factor for the development of periodontitis [22, 28].
C. Although severe periodontitis was significantly associated with obesity, it was not associated with overweight [33].

However, although current literature indicates that obesity has a relationship or acts as a risk factor for periodontal disease, the causal relationship still needs to be proven [23].

The current findings emphasize the importance of waist circumference levels in the assessment of periodontitis. There is a suggestion of a strong correlation between central obesity and periodontitis. Among individuals aged 30–60 years, the strength of this positive correlation is more pronounced than among those aged 60 years and older. However, validation by further prospective studies is still needed [18]. Overweight and obesity are among the main behavioral risks for periodontal disease tendency [20,23,27].

Obese patients had a higher risk of developing low oral brushing frequencies, probably due to discomfort due to their weight, and, consequently, had an increased presence of PD when compared with non-obese individuals. Therefore, it is possible that obesity acts as a risk factor that facilitates the presence of periodontitis due to deficiencies in daily tooth brushing [32]. It has been shown that being obese increases the risk of PD progression by 15%, but despite the higher prevalence of PD in obese individuals, obesity is not considered an independent risk factor for the development of periodontitis, corroborating that, in addition to obesity, the obese patient needs to have other factors to have this increased risk [28].

A strong positive association between BMI and WC was found with periodontal disease, especially regarding its prevalence. Studies have shown an association between increased BMI and periodontal parameters such as clinical attachment level and probing depth. Obesity measured by BMI is associated with a higher risk of acquiring periodontitis compared to individuals with normal weight [18, 19, 24, 25, 31]. In contrast, one study shows that periodontitis occurred independently of Metabolic Syndrome (MS), outlining that when a certain BMI level is reached, the suggested association between MS and PD may not be as significant [22]. Thus, there is evident divergence regarding this risk relationship between metabolic syndromes and PD.

Some studies recommend periodontal evaluation and clinical management of individuals with obesity, as predictions and detectors of this pathology, as well as the union of the medical and dental team in using obesity as a preliminary screening for the progression of periodontitis, which may be an alternative prevention protocol [25, 27,30].

Previously published studies also report an association between obesity and periodontal disease, showing that patients are more likely to present oral pathologies, especially periodontitis. However, the mechanisms involved in this relationship are not fully understood, requiring longitudinal studies to identify the true risk factors and, thus, establish the cause-effect [34, 35, 36].

5. CONCLUSION

The analysis of the results of this integrative review leads us to consider that obesity and, consequently, overweight, play a role in the process of systemic inflammation and that they can indirectly accelerate the onset and progression of

periodontal disease. In addition, this condition may represent a source of exacerbation of periodontitis due to hyperinflammation associated with adiposity, altered immune response, specific genetic polymorphisms and increased stress, which contribute to an intensification of the progressive inflammatory response of the condition. Furthermore, obese individuals may have a lower frequency of adequate oral hygiene, often due to discomfort due to their weight, which corroborates an increased prevalence of periodontal disease in these individuals.

Current literature shows the association of periodontal diseases with different systemic conditions, such as obesity and overweight. However, although current literature indicates that obesity has a relationship or acts as a risk factor for periodontal disease, the causal relationship needs to be proven with representative samples and long-term follow-up, as a primary way to obtain a better understanding of the association between these diseases.

REFERENCES

1. Deurenberg P, Yap M. The assessment of obesity: methods for measuring body fat and global prevalence of obesity. Res Clin Endocrinol Metab. 1999;13(1):1-11. Available at: https://pubmed.ncbi.nlm.nih.gov/10932673/. Accessed on: 19 June. 2024.

2. Halpern A. Obesity. In: Waschenberg BL. Textbook of clinical endocrinology. São Paulo: Roca; 1992. p. 911-929. Available at: https://www.scielo.br/j/abem/a/SFMMjbLMH3M6V4fcXMJRSzM/?lang=en. Accessed on: June 19, 2024.

3. Christino, V. G., et al. “Because We Are All Sick”: Challenges in Primary Health Care in the Time of Covid - 19. DEMETRA: Food, Nutrition & Health, v. 7, n. 1, 2024. Available at: https://www.e-publicacoes.uerj.br/demetra/article/view/77502/49253 . Accessed on: June 19, 2024.

4. Blumenkrantz, M. Obesity: the world's metabolic disorder [online]. Beverly Hills, 1997. Available at: http://www.quantumhcp.com.obesity.htm >. Accessed on: June 19, 2024.

5. World Obesity Federation (WOF) Incident cases and deaths attributable to overweight and obesity in Brazil until 2044. Eduardo Augusto Fernandes Nilson; Leandro Fórneas Machado Rezende; Oswaldo Cruz; Joyce Moreira Camargo. Available at: https://www.fiocruzbrasilia.fiocruz.br/quase-metade-dos-adultos-brasileiros-viverao-com-obesidade-em-20-anos/. Accessed on: August 13, 2024

6. World Health Organization. Obesity: Preventing and managing the global epidemic. Report of a WHO Consultation on Obesity Geneva: WHO; 1998. Available at: https://iris.who.int/handle/10665/42330. Accessed on: 19 June. 2024.

7. Stunkard AJ. Determinants of obesity: current opinion. In: Peña M, Bacallao J, editors. Obesity in poverty: a new challenge for public health [Scientific publication

no. 576]. Washington, D.C.: PAHO; 2000. Available at: https://pesquisa.bvsalud.org/portal/resource/pt/lil-381183. Accessed on: June 19, 2024.

8. Kac G, Velásquez-Meléndez G. The nutritional transition and the epidemiology of obesity in Latin America. Cad Saude Publica 2003; 19(1):4-5. Available at: https://www.scielo.br/j/csp/a/br6Lw9rL5TN5qmd3tN4f39L/. Accessed on: June 19, 2024.

9. Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. Nat Rev Dis. Primers. 2017 Jun;3:17038. Available at: https://doi.org/10.1038/nrdp.2017.38. Accessed on: 19. Jun. 2024.

10. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. (2014). Global burden of tooth loss: a systematic review and meta-analysis . J Dent Res 93 (7) :20S-28S. Available at: https://pubmed.ncbi.nlm.nih.gov/24947899/. Accessed on: June 19, 2024.

11. Eke, P. I. et al. Periodontitis in US adults. Journal of the American Dental Association (1939), vol. 149, no. 7, p. 576- 588.e6, 2018. Available at: https://pubmed.ncbi.nlm.nih.gov/29957185/. Accessed on 19 June. 2024.

12. Chen, M.X. et al. Global, regional, and national burden of severe periodontitis, 1990–2019: An analysis of the Global Burden of Disease Study 2019. Journal of clinical periodontology, v. 48, no. 9, p. 1165–1188, 2021. Available at: https://pubmed.ncbi.nlm.nih.gov/34101223. Accessed on: 19. Jun. 2024.

13. Madeiro, A. T. et al. Preventive approach to periodontal disease in diabetic patients: literature review. Journal of Dentistry of the City University of São Paulo, 2018. Available at: https://publicacoes.unicid.edu.br/revistadaodontologia/article/view/611. Accessed on: June 19, 2024.

14. Nascimento.G. G. et al. Is weight gain associated with the incidence of periodontitis? A systematic review and meta-analysis. Journal of clinical periodontology, v. 42, no. 6, p. 495–505, 2015. Available at: https://pubmed.ncbi.nlm.nih.gov/25952821/. Accessed on: 19 June. 2024.

15. Gaio EJ, Haas AN, Rosing CK, Oppermann RV, Albandar JM, Susin C. Effect of obesity on periodontal attachment loss progression: a 5-year population-based prospective study. J Clin Periodontol 2016;43(7):557-65. Available at: https://pubmed.ncbi.nlm.nih.gov/26970086/. Accessed on: 19 June. 2024.

16. Khader, Y. S. et al. The association between periodontal disease and obesity among adults in Jordan. Journal of clinical periodontology, v. 36, no. 1, p. 18–24, 2009. Available at: https://pubmed.ncbi.nlm.nih.gov/19046327/. Accessed on: 19 June. 2024.

17. Teixeira, V. G. Relationship between Obesity and the Development of Periodontal Disease. Available at: <https://www.unirv.edu.br/conteudos/fckfiles/files/VANESSA%20GONCALVES%20TEIXEIRA.pdf>. Accessed on: June 19, 2024.

18. Botelho, L.;Cunha, C.; Macêdo, M. The integrative review method in organizational studies. Management and Society, [online], v. 5, n. 11, p. 121-136, December 2, 2011. Available at:

https://www.gestaoesociedade.org/gestaoesociedade/article/view/1220. Accessed on: June 19, 2024.

19. Xu, L. et al. Association between weight-adjusted waist index and periodontitis: A population-based study. PloS one, v. 19, no. 6, p. e0305010, 2024. Available at: https://pubmed.ncbi.nlm.nih.gov/38843124/. Accessed on: 19 June. 2024.

20. Liu, L. et al. Association between obesity and periodontitis in US adults: NHANES 2011–2014. Obesity facts, v. 17, no. 1, p. 47–58, 2024. Available at: https://pubmed.ncbi.nlm.nih.gov/37935140/. Accessed on: 19 June. 2024

21. Alves-Costa, S., Leite, F.R.M., Ladeira, L.L.C. et al. Behavioral and metabolic risk factors associated with periodontitis in Brazil, 1990–2019: a multidimensional analysis for the Global Burden of Disease Study 2019. Clin Oral Invest 27, 7909–7917 (2023). https://doi.org/10.1007/s00784-023-05384-6

22. Ramírez, V., Weber, L., Hernández, M. et al. Obesity is related to the severity of maternal periodontitis in pregnancy: a cross-sectional study. Clin Oral Invest 27 , 5509–5518 (2023). https://doi.org/10.1007/s00784-023-05170-4

23. Nilsen, A., Thorsnes, A., Lie, S. A. et al. Periodontitis in obese adults with and without metabolic syndrome: a cross-sectional study. BMC Oral Health 23 , 439 (2023). https://doi.org/10.1186/s12903-023-03133-5

24. Yang, Q., Wang, X., Li, C. et al. A cross-sectional study on the relationship between visceral adiposity index and periodontitis in different age groups. Sci Rep 13 , 5839 (2023). https://doi.org/10.1038/s41598-023-33082-6

25. Abu-Shawish G, Betsy J, Anil S. Is obesity a risk factor for periodontal disease in adults? A systematic review. International Journal of Environmental Research and Public Health . 2022; 19(19):12684. https://doi.org/10.3390/ijerph191912684

26. Carneiro, DO, Gomes-Filho, IS, da Cruz, SS et al. Obesity in young women is positively associated with periodontitis. Clin Oral Invest 26 , 6139–6149 (2022). https://doi.org/10.1007/s00784-022-04563-1

27. Čolak, D., CmokKučič, A., Pintar, T. et al. Periodontal and systemic health of morbidly obese patients eligible for bariatric surgery: a cross-sectional study. BMC Oral Health 22 , 174 (2022). https://doi.org/10.1186/s12903-022-02207-0

28. Charupinijkul, A., Arunyanak, S., Rattanasiri, S. et al. The effect of obesity on the progression of periodontitis: a 10-year retrospective cohort study. Clin Oral Invest 26 , 535–542 (2022). https://doi.org/10.1007/s00784-021-04031-2

29. de Almeida Barros Mourão, C., Javid, K. & Casado, P. Does obesity directly correlate to periodontal disease, or could it be only one of the risk factors?. Evid Based Dent 22, 160–161 (2021). https://doi.org/10.1038/s41432-021-0229-4

30. GanesãSM ,Vazana S , Chair S . From the waist to the gum line: Relationship between obesity and periodontal disease - biological and management considerations . Periodontal 2000 .2021 ; 87 : 299–314 . https://doi.org/10.1111/prd.12390

31. Alsalihi, L., Bain, C., Milosevic, A. et al. Prevalence of periodontitis in obese patients in Bahrain: a cross-sectional study. BMC Oral Health 21, 376 (2021). https://doi.org/10.1186/s12903-021-01720-y

32. Maulani C, Auerkari EI, C. Masulili SL et al. Obesity correlated to a higher risk of acquiring periodontitis: a cross-sectional study [version 2; peer review: 2 approved]. F1000Research 2022, 10:643 (https://doi.org/10.12688/f1000research.53823.2)

33. Guzmán Gastelum DA, HuezGonzález A, FornelliMartín del Campo LF, et al. Evaluation of oral hygiene and periodontal characteristics in patients with obesity: case-control study. Rev ADM. 2020;77 (2):62-69. doi:10.35366/93097.

34. Santos, Taise; Cury, Patricia Ramos; Santos, Edvaldo; Vasconcelos, Rebeca; Santos, Jean Nunes Dos; Ramalho, Luciana Maria Pedreira. Association between severe periodontitis and degree of obesity: a preliminary study. Oral Health Prev Dent ; 17(2): 173-177, 2019. DOI: 10.3290/j.ohpd.a42374

35. MACHADO, Eduardo; ZANATTA, Gustavo Batistin; ASSIS, Camila de Azevedo de and ZANATTA, Fabrício Batistin. Obesity as a risk factor for periodontitis: is it possible?. RGO, Rev. gaúch. odontol. (Online). 2011, vol.59, suppl.1, pp. 45-50. ISSN 1981-8637

36. Bertolini, Patrícia & Filho, Oswaldo & Pomilio, Arnaldo & Alves, Patrícia. (2012). Periodontal disease and obesity: is there any relationship?. Journal of Medical Sciences. 19. 10.24220/2318-0897v19n1/6a830.

37. Prevalence of risk factors for oral diseases in obese patients referred for bariatric surgery Bastos, Isis Henriques de Almeida et al. The Journal of the American Dental Association, Volume 149, Issue 12, 1032 - 1037.