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The Relationship between Body Mass Index and Periodontitis

Supervised by:

Dr. Malath Azeez Dr. Sura Dakhil

Presented by:

Ali Raad Saad
Laith Hamdi Ajam
Mohammad Ali Huzam
Tuka Waleed Johi
Yousif Ayoob Nadhim
Youssra Ammar Jundy

Abstract

Background: Obesity is a chronic disease of a multifactorial cause that affects the general population. Obesity has been recommended to be a one of the risk factors of periodontal diseases which are inflammatory diseases affecting the supporting tissues of the teeth. The aim of the current study was to evaluate the relationship between obesity measured by body mass index and periodontitis.

Materials and Methods: A total of 120 periodontitis patients were incorporated in the study. The diagnosis of periodontitis was based on the newest international classification of periodontitis. The clinical periodontal parameters were recorded and body mass index for each patient were calculated. The patients were classified according to their body mass index as normal weight, overweight and obese groups

Results: The highest percentage of the patients was found in obese group (41%) while the lowest percentage was found in normal weight group (19%). There were significant differences among groups regarding body mass index and clinical attachment loss while there were no significant differences among groups regarding other parameters. Least significant difference test showed that there was a significant difference between normal weight and overweight group regarding clinical attachment loss. Also, there were significant differences among all groups regarding body mass index. No significant correlations were found between body mass index and clinical periodontal parameters.

Conclusions: Body mass index more than normal was associated with increased prevalence of periodontitis. Conversely, no correlation was identified between body mass index and the clinical periodontal parameters.

Keywords: Periodontitis, Periodontal Disease, Body Mass Index, Obesity

Introduction

Periodontitis is infection-driven inflammatory disease in tooth-supporting tissues (i.e., the periodontium). Moreover, genetics and environmental and behavioral factors are involved in the development of the disease, the exposure of susceptible individuals to its initiation, and the speed of progression. The structure of the periodontium is diverse; it is composed of the gingiva, the underlying connective tissue, cementum on the root surface, alveolar bone, and the periodontal ligament between the cementum and alveolar bone.[1]

The most characteristic feature of periodontitis is the activation of osteoclastogenesis and the destruction of alveolar bone as its consequence, which is irreversible and leads to loss of tooth support.[1]

Periodontal disease is highly prevalent in adult-aged populations all over the world, with prevalence rates around 50%.[1]

Certain demographic characteristics, such as age, gender, ethnicity, and socioeconomic status, influence the prevalence of periodontitis. Other strongly contributing factors include smoking, diabetes mellitus, metabolic syndrome, and obesity.[2,3]

Environmental factors may also contribute to the onset and progression of periodontitis, but these are currently less well understood. The dysregulated immune reactions ultimately lead to host-mediated damage and breakdown of the periodontal tissues including the alveolar bone. Clinical phenotypes may vary, with some patients presenting with severe periodontal breakdown at a relative young age.[4]

A new classification of periodontal diseases aimed to identify periodontal disease based on a multidimensional staging and grading system has been proposed. Staging is dependent upon the severity and complexity of disease, whereas grading is

intended to assess the likelihood of the disease progressing at a greater rate than normally expected or responding less predictably to therapy.[5]

Stages I and II are based on the level of clinical attachment loss (CAL) and bone loss (BL).

The diagnosis is Stage I if:[5]

- BL is less than 15%.
- CAL is between 1-2mm.

The diagnosis is Stage II if:[5]

- BL is between 15% -33%
- CAL is between 3-4mm.

The diagnosis is Stage III if:[5]

- (a) BL affects the middle third of the root or beyond,
- (b) CAL is 5mm or more,
- (c) periodontal tooth loss (PTL) is four teeth or fewer,
- (d) 10 or more occluding pairs are present
- (e) in the absence of bite collapse, drifting, flaring, or a severe ridge defect.

The diagnosis is Stage IV if:[5]

- (a) BL reach to the apical third of the root,
- (b) CAL is 5mm or more,
- (c) PTL is more than four teeth,
- (d)there are fewer than 10 occluding pairs, or
- (e) when there is bite collapse, drifting, flaring, or a severe ridge defect.

Grading can be classified according to CAL and %BL/age into:[5]

- Grade A %BL/age < 0.5 + no more CAL over 5 years
- Grade B %BL/age =0.5-1 + CAL < 2mm over 5 years
- Grade C %BL/age > 1 + CAL > 2mm over 5 years.

Extent and distribution:

- Localized < 30% teeth -Generalized ≥ 30% teeth

Obesity:

Overweight and obesity involve abnormal or excessive fat accumulation that may impair health and are considered major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and also periodontitis.[6] Childhood obesity results in the same conditions, with premature onset, or with greater likelihood of developing these diseases as adults. Thus, the economic and psychosocial costs of obesity alone, as well as when coupled with these comorbidities are striking.[7] According to the World Health Organization (WHO),[6] in 2016, more than 1.9 billion adults were overweight and, of these, over 650 million were obese. Worldwide obesity has nearly tripled since 1975 and most of the world's population live in countries where overweight and obesity kills more people than underweight. This epidemic is far from its resolution, since 41 million children under the age of 5 and over 340 million children and adolescents aged 5 to 19 were overweight or obese in 2016.[6]

Body mass index:

Body mass index (BMI, calculated as weight in kg/height^2 in meters) provides the most useful population-level measure of overweight and obesity. However, it should be considered a rough guide because it may not correspond to the same degree of fatness in different individuals. For adults, the WHO defines overweight as a BMI greater than or equal to 25; and obesity a BMI greater than or equal to 30.[6]

Periodontitis and obesity:

The association between obesity and periodontitis was first reported in 1977, when changes in the periodontium of obese rats was found.[8] The first human study reporting this relationship was conducted by Saito et al.[9] In this study, the periodontal status of 241 healthy Japanese subjects was assessed. The authors observed that the relative risk of periodontitis was 3.4 in subjects with BMIs of 25.0 to 29.9 kg/m , and 8.6 in those with BMIs of ≥ 30 kg/m , compared with subjects with BMIs of < 20 kg/m.[9] Since then, some systematic and non-systematic reviews have been published regarding this association. However, the level of evidence is low, as they include mainly cross-sectional studies, whilst prospective evidence is scarce.[10] In addition, there are several confounding factors related to obesity that should be clarified to elucidate the direction of this association. In a systematic review, Moura-Grec et al[11] found an association between periodontitis and obesity in 17 studies, a trend in 8 studies, and no association in 6 studies. When they compared normal weight, overweight and obesity, they observed an odds ratio (OR) of 1.30 (95% confidence interval [CI] 1.25 to 1.35) of the risk to have periodontitis in an obese subject. Data from a systematic review by Keller et al[8] including interventional and longitudinal studies showed that overweight,[10] obesity,[12,13] weight gain[13] and increased waist ratio[8,9] are risk factors directly associated with developing or worsening periodontitis.

The aim of the current study was to evaluate the relationship between body mass index and periodontitis.

Materials and Methods

Sample:

This study was conducted on 120 patients with periodontitis, consisting of (60) female and (60) male, with an age range of 30–60 years. The protocol of the study was approved by the ethics committee of department of periodontology. The aim of the study was explained to all subjects participating in this study and informed consents were obtained.

Inclusion criteria:

Patients enrolled in the study were without any history of smoking or systemic conditions, none of them had taken medications over the past three months or underwent a periodontal treatment over the past six months and the females were non-pregnant. All the patients were suffering from periodontitis and were diagnosed with periodontitis using the following criteria from 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions:

- interdental clinical attachment loss (CAL) at ≥2 non-adjacent teeth, or
- buccal/oral CAL ≥3 mm with a probing depth (PD) >3 mm at ≥2 teeth

and the observed CAL should not be ascribed to non-periodontal causes.[5]

Methods:

Demographic data, including age, gender and educational achievement were obtained by filling a questionnaire and the weight and height were obtained by using a body weight digital floor scale and measuring tape, respectively. The Body Mass Index (BMI) was calculated for each patient from dividing the body weight in kilograms by the square of the body height in meters and then categorized according to World Health Organization criteria as[14]:

- Underweight: BMI < 18.5 kg/m^2

- Normal weight: BMI = 18.5–24.9 kg/m^2
- Overweight: BMI = 25.0 – 29.9 kg/m^2
- Obesity: BMI ≥ 30 kg/m^2

None of the 120 patients showed underweight records and there for the study groups classified as group 1 with normal weight, group 2 with overweight and group 3 which included obese patients.

The presence of plaque (PLI) was assessed following Sillness and Loe Plaque Index (1964).[15] Bleeding on probing (BOP) is expressed as percentage and is obtained by gentle probing of the orifice of the gingival crevice and if bleeding occurs within 60 seconds a positive finding is recorded.[16] Probing pocket depth (PPD) measured as the distance from the gingival margin to the base of probeable crevice.[16] Clinical attachment loss (CAL) measured as the distance from the cementoenamel junction (CEJ) to the base of the probeable crevice.[16] The previous periodontal parameters were measured at six sites (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual) for all teeth by using University of North Carolina-15 probe and World Health Organization (WHO) probe.

Statistical analysis:

The study variables were statistically analyzed using Statistical Process for Social Science (SPSS version 20). Statistical analysis include percentages, means and standard deviation. Analysis of variance (ANOVA) test was used to compare means among groups, also Least significant difference (LSD) test was used to compare between each two groups individually. Chi-square (X^2) test used to compare percentages among groups. The correlations among BMI and the values of clinical parameters were calculated by Pearson correlation coefficient. *P-value* < 0.05 regarded as statistically significant.

Results

Current study found that none of the 120 patients showed underweight records and there for the study groups classified as group 1 with normal weight, group 2 with overweight and group 3 which included obese patients. The highest percentage of the patients was found in obese group (41%) while the lowest percentage was found in normal weight group (19%) as shown in table 1.

As well as present study found that in obese group the predominant percentage was female (57%) while male patients were predominant in overweight group (56%) but there were no significant differences among groups as shown in table 1.

Table 1: Percentages, Gender and Education Level for normal weight, overweight and obese groups.

		Normal Weight Group	Overweight Group	Obese Group	Chi-Square	P-Value
Number (percentage)		23 (19%)	48 (40%)	49 (41%)		
Gender	Female	11 (48%)	21 (44%)	28 (57%)	1.79	0.41
	Male	12 (52%)	27 (56%)	21 (43%)		
Education level	Primary education	6 (26%)	21 (44%)	20 (41%)	5.34	0.25
	Secondary education	12 (52%)	12(25%)	17 (35%)		
	High education	5 (22%)	15 (31%)	12 (24%)		

Comparisons of means involving (age, BMI, plaque index, BOP, PPD and CAL) showed that there were significant differences among groups regarding BMI and CAL while there were no significant differences among groups regarding other parameters as shown in table 2.

Table 2: Comparison of means (age, BMI, plaque index, BOP, PPD and CAL) in all groups.

	Normal weight group Mean ± std. Deviation	Overweight group Mean ± std. Deviation	Obese group Mean ± std. Deviation	ANOVA	P-Value
Age	37.65± 9.29	42.38± 8.92	45.02± 9.24	5.11	0.7
BMI	22.53± 1.89	27.29± 1.50	34.06± 3.60	83.66	0.00
Plaque index	1.56± 1.02	1.28± 0.62	1.21± 0.64	1.92	0.15
BOP	34.85± 27. 04	32± 0.25	37. 69± 27.23	0.47	0.627
PPD (worst)	3.74± 0.92	3.47± 0.77	5.59± 0.91	0.79	0.458
CAL (worst)	3.71± 1.74	4.21± 1.08	5.03± 1.7	3.69	0.02

Furthermore Least significant difference test showed that there was a significant difference between group 1 and 2 regarding CAL. Also there were significant differences between {(group 1 and 2), (group 1 and 3) and (group 2 and 3} regarding BMI as shown in table 3.

Table 3: Least significant difference test to compare mean differences among group

		MEAN DIFFERENCE	P-VALUE
CAL	Group 1 and Group 2	0.820	0.008
	Group 1 and Group 3	0.322	0.394
	Group 2 and Group 3	-0.49	0.19
BMI	Group 1 and Group 2	1.07	0.00
	Group 1 and Group 3	4.75	0.00
	Group 2 and Group 3	4.76	0.00

Finally current study found that there were no significant correlations among BMI and clinical periodontal parameters as shown in table 4.

Table 4: Correlation of BMI with (PPD, CAL and BOP)

	r	P - value
BMI and PPD	0.03	0.75
BMI and CAL	0.039	0.67
BMI and BOP	0.029	0.75

Discussion

Current study showed that the distribution of patients with periodontitis across different BMI categories reveals that the majority fall within the overweight and obese groups, comprising 40% and 41% respectively, while only 19% belong to the normal weight group. This may indicate that periodontitis is more prevalent among obese/overweight people than normal weight people, suggesting that there may be a correlation between the prevalence of periodontitis and higher BMI levels.

These results align with other studies including ***Suvan et al. (2015)***[17] that reported that the overweight/obese individuals are more likely to suffer from periodontitis compared to normal weight individuals based on a sample representative of the UK population BMI distribution with a prevalence (49.0%) of overweight/obese (BMI $\geq$ 25) that is similar to that for the English population (50%) at the time of study recruitment. ***Khader et al. (2009)***[18] reported that periodontitis is more prevalent in obese and overweight patients, with 29.6% of overweight and 51.9% of obese participants in the study having periodontitis compare to only 14% of normal weight

participants from a systematic random sample of 340 Jordanian aged 18 and 70 years.

The relationship between obesity and periodontitis is complex, and various factors contribute to the higher prevalence of periodontitis in individuals with obesity. A state of inflammation that results from obesity may increase host susceptibility to periodontal breakdown as adipose tissues secrete cytokines such as tumor necrosis factor, interleukin-6 and hormones which believed to increase overall inflammation and produce an inflammatory overload. With increased levels of adipose tissue, pro-inflammatory mediators increase while anti-inflammatory mediators decrease. Research indicates such dysregulation of cytokine activity creates a chronic low-grade inflammatory state and modifies metabolic and immune responses that influence host susceptibility to disease. Moreover, modifications in the inflammatory system increases production of reactive oxygen species that results in a chronic oxidative state and can lead to the initiation and progression of chronic disease.[19][20]

Present study found that females constituted the predominant percentage (57%) in the obese group, whereas males were predominant (56%) in the overweight group. Females have been widely reported to have higher BMIs and higher rates of obesity than males this is maybe due to biological reasons including gender differences in fat metabolism and also due to cultural restrictions such as limiting access to exercise.[21][22]

Comparisons of means involving (Age, BMI, PI, BOP, PPD, CAL) revealed significant differences among groups for BMI and CAL, but not for the other parameters. We conducted Least Significant Difference (LSD) test for BMI and CAL to identify the groups whose means are statistically different. There were

significant differences between groups regarding BMI, indicating that the grouping was reasonable and the experimental data had high comparability and significance. Regrading CAL, while present study revealed a significant difference in the CAL between the normal weight and overweight groups (P = 0.008), no such significance was observed between the normal weight and obese groups or between the overweight and obese groups, this is in contrast to other studies.

A case control study conducted by ***Ghazal et al. (2023)*** that involved 208 patients in total, 104 individuals in the case group (obese, BMI ≥ 30) and 104 in the control group (BMI ≤ 24) found that the CAL and PPD was significantly higher in obese group more than normal weight group.[23] ***Jia et al. (2023)*** found that the PPD and CAL were significantly higher in overweight patients and obese patients than those in normal body weight patients, but there was no statistically significant difference in PPD and CAL between overweight and obese groups.[24]

Regarding the correlation between BMI and the clinical periodontal parameters (CAL, PPD & BOP), current study found that there were no significant correlations. The results of the present study are in contrast to some previous studies which suggest a relationship between increased BMI and the clinical periodontal parameters. ***Ghazal et al. (2023)*** evaluate the obesity based on BMI and waist-hip ratio (WHR) and found that the degree of obesity (both BMI and WHR) of the patients was significantly positively correlated with PPD and CAL.[23] ***Çetin et al. (2022)*** found that BMI was statistically associated with CAL, PPD, PI, stage and grade of periodontitis and number of remaining teeth.[25] ***Maulani et al. (2022)*** found that he clinical parameters of periodontitis (PD, CAL, recession and BOP) presented positive correlations with BMI.[26]

The results of the present study are consistent with a study conducted by ***de Castilhos et al (2012)*** who reported no association between periodontitis (measured by pocket depth) and obesity (measured by waist circumference) among 720 young people.[27] According to this study periodontitis might have been underestimated by using PPD only, due to possible presence of CAL without the presence of the pocket, but in the present study we assessed the periodontitis using the newest 2017 periodontal disease classification. de Castilhos et al reported that the probable reason for lack of association was the age of the participants who were young (about 20 to 30 years old) but in present study we selected middle aged patients (30 – 60).[27] A study by ***Banihashemrad et al. (2018)*** also didn't find an association between BMI ≥ 25 and periodontal parameters. They suggests that plaque accumulation, might have a more pronounced effect on periodontal health compared to obesity, therefore, failure to matching the samples was the cause to the lack of association in their study.[28]

In present study, as a measure of obesity, we used BMI. Height and weight are the simplest and commonly used measures, and a number of indices have been developed, including the widely used BMI. BMI generally correlates highly with overall adiposity, although it can sometimes misclassify total body fat content. For example, athletes who are muscular have a high BMI, because muscles weigh more than fat, and have BMIs in the overweight range, even though they are not obese.[29] Also for similar BMI, aged individuals have a tendency to have an elevated body fat composition; and consequently, risk measurement by BMI is less precise in older people.[30] Body fat distribution judged by the dimension of waist circumference, with 102 cm in male and 88 cm in female, respectively, being the cut-off point for abdominal obesity linked with an high risk of morbidity. Waist circumference (WC) give you an idea about a close association with the quantity of visceral adipose tissue, and this has been revealed to be metabolically more active and to secrete far large

quantity of cytokines and hormones measure up to with subcutaneous adipose tissue.[19]

Kim et al. (2011) found a significant association between abdominal obesity (measured by WC) and periodontitis, whereas there was no association between BMI and periodontitis.[31] ***Alsalihi et al. (2021)*** found that BMI was not correlated with periodontitis but WC had a positive correlation based on cross-sectional study was conducted in overweight Bahrainis.[32]

Large studies have indicated that measurement of WC or WHR may be a better disease risk predictor than BMI,[19] and research is ongoing to determine whether BMI, WC, or both should be used to assess disease risk.[29]

Other limitation of the present study was its cross-sectional design. We also did not evaluate factors influencing life style such as emotional status, diet and other items. However, the effect of these variables may have been possible.

Conclusion and Recommendations

Within the limitations of the present study, we found an association between increasing BMI more than normal and the prevalence of periodontitis. Conversely, no correlation was identified between BMI and the clinical periodontal parameters.

The complex nature of this relationship calls for deeper exploration, suggesting at the need for longitudinal clinical trials, larger sample sizes, utilization of obesity measurement techniques beyond BMI, and consideration of lifestyle influences to establish causal relationship.

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