Research Article

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Risk Assessment for Severity of Obesity and Progression of Periodontal Disease

Shruti Jain[1*] Bela Dave[2] Parth Khamar[3] Viral Thakker[4] Khushboo Shah[5] Mihir Patel[6]

[1]PG Student, Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
[2]Professor and Head, Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
[3]Senior Lecturer, Department of Pedodontics, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
[4]Reader, Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
[5]PG Student, Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
[6]PG Student, Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.

ABSTRACT

Background: The purpose of this study was to evaluate the relationship between obesity and periodontitis. pathophysiology of obesity has evolved over recent decades to recognize that chronic inflammation, rather than a simple mechanical burden, drives its morbidity. Cardiovascular disease, one of the main complications of obesity, is also understood to be driven by the chronic inflammation associated with periodontal diseases. To evaluate the Body Mass Index (BMI), Body Fat Percentage (BF%), Waist Circumference (WC) and periodontal status, Periodontal Pocket Depth (PD), Oral Hygiene Status (OHI-S), gender-based differences in terms of obesity and periodontal status among participants.

Materials and Methods: A total of 100 patients (aged between 25-55 years) visiting the Department of Periodontology, A.M.C dental college, Ahmedabad were analysed for obesity and periodontal status after obtaining ethical approval from the ethical committee. Obesity was measured using Body Mass Index (BMI), Body Fat Percentage (BF%) and Waist Circumference (WC).

Results: Statistical analysis had been done using chi Square Test and mean showed *P = <0.005* indicating there was a statistically significant difference in the findings between obese and non-obese individuals. Correlation between obesity and periodontitis is 68.5% and non-obese and periodontitis is 31.5%

Conclusion: It was found in this cross-sectional study obese population has a greater risk of periodontitis as compared to the non-obese population.

Keywords: Obesity, Body mass index, Body fat percentage, Waist circumference, Periodontitis.

INTRODUCTION

According to the World Health Organization (WHO), obesity is one of the most common, yet among the most neglected, public health problems in both developed and developing countries,[1].In a study conducted in urban north India (New Delhi), the overall prevalence of generalized obesity(GO) was 50.1%, while that of abdominal obesity(AO) was 68.9 %,[2].In India, abdominal obesity is one of the major risk factors for cardiovascular disease (CVDs).

The purpose of the study was to investigate whether obesity is associated with periodontitis. We hypothesized that the prevalence of periodontitis is higher in obese people than in non-obese people.

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*Correspondence Dr. Shruti Jain.
Department of Periodontology, AMC Dental College and Hospital, Ahmedabad, Gujarat, India.
Email: Not Disclosed

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MATERIAL AND METHOD

This study was conducted amongst participants visiting the Outpatient Department of Periodontology at Ahmedabad Municipal Corporation Dental College, Ahmedabad, Gujarat. The study was approved by the Institutional Review Board and the study was conducted from September 2018 to January 2019. The study sample size included 100 adults (50 Non-Obese and 50 Obese participants without gender bias) from the age group between 25-55 years. After obtaining written informed consent, Body Mass Index(BMI), Body Fat Percentage (BF%), Waist Circumference(WC) according to WHO reference standards, Periodontal Pocket Depth(PPD) with UNC-15 probe, Oral Hygiene Status was recorded for each participant.

Inclusion criteria:

Non-obese and obese participants aged 25-55 years were included irrespective of gender, sex, religion, and socioeconomic status.

Exclusion criteria:

1) Pregnant women and lactating mothers.
2) A participant with alcohol or drug abuse, suffering from systemic diseases, any infectious disease requiring antibiotic treatment and past periodontal treatment within 6 months before the examination.
3) Participants were unwilling to give informed written consent.

Data collection:

Participants were selected by stratified sampling technique by the principal investigator. Each participant was examined by a single examiner on a dental chair under proper illumination. The observations were recorded on a printed performa.

Body mass index was calculated by dividing weight in kilograms (kg) by height in meters squared (m^2)[BMI = kg/m^2] according to WHO criteria,[1]. Weight was measured using the "weighing scale" in kilograms and height was measured "height measuring stand" in centimeters and then converted into meters.

An individual was categorized as obese if the BMI was ≥30 and non-obese if the BMI was <30.

Body fat percentages (BF%) was calculated for men using formula [(1.20 x BMI) + (0.23 x age) – 10.8 – 5.4] and for women using formula [(1.20 x BMI) + (0.23 x age) – 5.4] according to WHO criteria.,[1].

Waist Circumference(WC) was measured at the midpoint between the lower border of the rib cage and the iliac crest using measuring tape by the WHO criteria.,[1].

For statistical analysis, different cut-off values for obesity of BF% and WC among men and women were used. Men were defined to be obese if the BF% was >25% and WC ≥102 cm. For women, the corresponding cut-off values were BF % >35% and WC ≥88 cm.

Periodontal infection was assessed through the presence of teeth with periodontal pockets of 4 mm deep or deeper with the UNC-15 periodontal probe.

Oral hygiene was categorized as good, fair and poor according to Oral Hygiene Index- Simplified(OHI-S) [John C Greene and Jack R Vermillion in 1964],[3].

Statistical analysis

Collected data were entered in Microsoft excel (2010) spreadsheet to prepare a master chart and an excel sheet was forwarded to a statistician for statistical analysis. The data were analyzed with IBM SPSS 20 for windows statistical software. Statistical analysis was analyzed by the Chi-Square test for categorical data. For all statistical analyses, probability levels of $P < 0.05$ was considered statistically significant.

RESULTS

Statistical analysis had been done using chi Square Test and mean showed *P = 0.00006* indicating there is a statistically significant difference in the findings between obese and non-obese individuals.Correlation of obesity and periodontitis is 68.5% and non-obese and periodontitis is 31.5% as shown in Table 1 and Graph 1- Graph 3.

Effect of Oral Hygiene Index-Status(OHI-S) in obese and non-obese participants on the occurrence of periodontitis is shown in Table 2 and graph 4.

Table 1: Prevalence of periodontal disease according to Body Mass Index(BMI), Body Fat Percentage (BF%) and Waist Circumference (WC):

Parameters	Group	Periodontitis	Gingivitis	Total	P-Value
Body Mass Index	Obese, ≥30	37	13	50	*0.00006*
	Non-obese, <30	17	33	50	
	Total	54	46	100	
Body Fat Percentage, among men	≤25	5	18	23	*0.00478*
	>25	15	5	20	
	Total	20	23	43	
Body Fat Percentage, among women	≤35	6	10	16	*0.033231*
	>35	28	13	41	
	Total	34	23	57	
Waist Circumference, among men	<102	13	21	34	*0.034443*
	≥ 102	7	2	9	
	Total	20	23	43	
Waist Circumference, among women	<88	4	5	9	0.310974
	≥88	30	18	48	
	Total	34	23	57	

As per Table 1 when the effect of body mass index (BMI) with Periodontal conditions was studied the result showed a significantly higher prevalence of periodontitis in obese individuals as compared to non-obese individuals (P value=*0.00006).*

When effect of body fat percentage (BF%) in relation to Periodontal conditions was studied the result showed significantly higher prevalence of periodontitis in obese male individuals as compared to non-obese male individuals (P value=*0.00478)* and there was statistically significantly higher prevalence of periodontitis in obese female individuals as compared to non-obese female individuals (P value=*0.033231).*

When the effect of waist circumference(WC) in relation to Periodontal conditions was studied the result showed significantly higher prevalence of periodontitis in obese male individuals as compared to non-obese male individuals (P value=*0.034443)* and prevalence of periodontitis in obese female individuals as compared to non-obese female individuals is not statistically significant (P value=0.310974).

Table 2: Prevalence of periodontal disease according to good Oral Hygiene Index-Status (OHI-S) in obese and non-obese participants:

PARAMETER	BODY MASS INDEX(BMI)		PERIODONTITIS / GINGIVITIS	TOTAL	P VALUE
OHI-S INDEX	OBESE 30 AND > 30	NON-OBESE <30			
GOOD	1	5	PERIODONTITIS	6	0.259
	2	2	GINGIVITIS	4	
TOTAL	3	7		10	

As per Table 2 when the effect of oral hygiene index-status concerning Periodontal conditions was studied the result showed an obese individual who maintained good oral hygiene the occurrence of periodontitis was not statistically significant (*P* =0.259).

Table 3: Prevalence of periodontal disease according to fair Oral Hygiene Index-Status(OHI-S) in obese and non-obese participants

Parameter	Body Mass Index(BMI)		Periodontitis / Gingivitis	Total	P Value
Ohi-S Index	Obese 30 And > 30	Non-Obese <30			
Fair	20	4	Periodontitis	24	*0.000063*
	9	22	Gingivitis	31	
Total	29	26		55	

When the effect of oral hygiene index-status with Periodontal conditions was studied the result showed obese individuals who had fair oral hygiene the development of periodontitis was statistically significant (*P =0.000063*).

Table 4: Prevalence of periodontal disease according to poor Oral Hygiene Index-Status(OHI-S) in obese and non-obese participants.

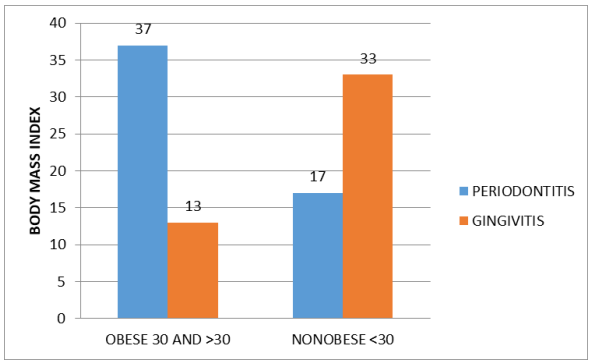
PARAMETER	BODY MASS INDEX(BMI)		PERIODONTITIS/GINGIVITIS	TOTAL	P VALUE
OHI-S INDEX	OBESE 30 AND > 30	NON-OBESE <30			
POOR	16	8	PERIODONTITIS	24	*0.0077*
	2	9	GINGIVITIS	11	
TOTAL	18	17		35	

When the effect of oral hygiene index-status with Periodontal conditions was studied the result showed obese individuals who had poor oral hygiene the development of periodontitis was statistically significant (*P =0.0077*).

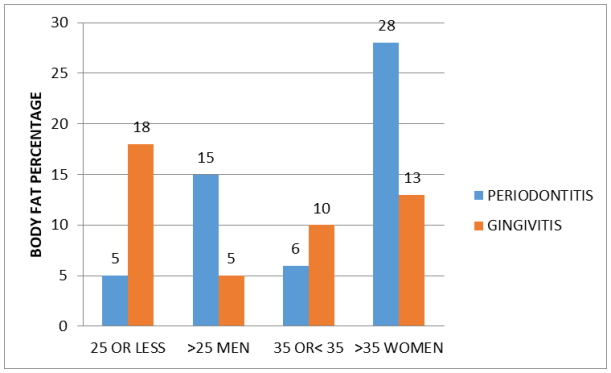
DISCUSSION

The World Health Organization has identified the importance of addressing common risk factors to

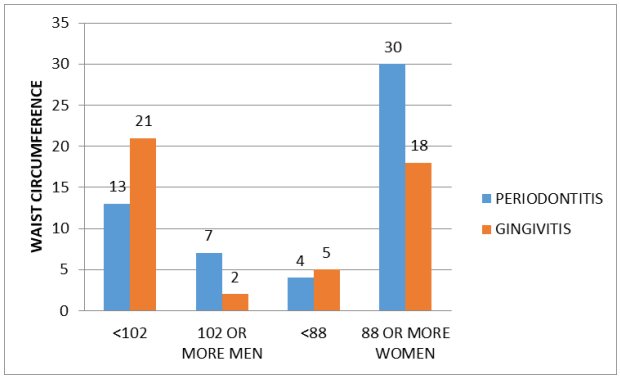
reduce the prevalence of non-communicable diseases, including obesity. The most common risk factors for weight gain or obesity are tobacco cessation, consumption of foods high in saturated and trans-fats, salt intake, sugar consumption (especially in sweetened drinks), sedentary lifestyle, as well as excessive alcohol consumption. Individuals with irregular and insufficient sleep patterns are at a higher risk of weight gain. Besides, several medications are associated with weight gain. These medications include some antidepressants, anti-seizure medications, diabetes medications, antipsychotic medications, steroids, and beta-blockers.



Graph 1: Prevalence of gingivitis and periodontitis in obese and non-obese participants according to Body Mass Index(BMI).

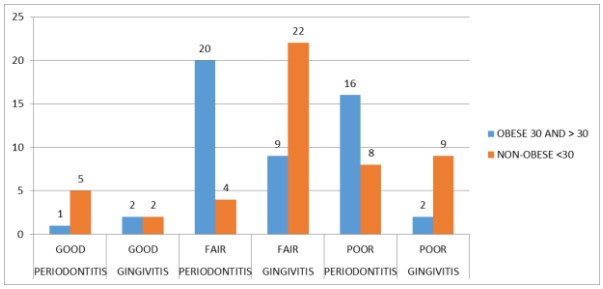


Graph 2: Prevalence of gingivitis and periodontitis in obese and non-obese participants according to Body Fat Percentage (BF%) along-with gender-based differences.



Graph 3: Prevalence of gingivitis and periodontitis in obese and non-obese participants according to Waist Circumference (WC) along-with gender-based differences.

Between 1960-80, the prevalence of overweight and obesity among adults and overweight among children was relatively constant. About 13% of adults were obese and 5% of children were overweight,[4]. However, according to the **third National Health and National Examination Survey (NHANES)**, between 1988-91, the prevalence of obesity among adults has doubled, and the prevalence of overweight among children and adolescents has tripled.



Graph 4: Prevalence of gingivitis and periodontitis according to oral hygiene index-simplified(OHI-S) in obese and non-obese participants.

Obesity increases host susceptibility by modulating the host immune and inflammatory system, leaving the patient with a greater risk of periodontitis. Obesity affects host immunity. It impairs the cell-mediated immune response and decreases lymphocyte immune function and natural killer T-cell activity as seen in the rat model,[5].

The first report on the relationship between obesity and periodontal disease appeared in 1977 when Perlstein et al., found alveolar bone resorption to be greater in obese animals compared to non-obese Zucker rats,[6]. This is in agreement with a more recent report from Amar et al,[7] that confirmed the dysregulation of immune responses in a periodontitis animal model resulting in increased bone loss.

Goodson et al (2009), suggested three mechanisms by which oral bacteria may contribute to the development of obesity. First, oral bacteria may contribute to increased metabolic efficiency, as suggested by the infectobesity proponent. The second hypothesis is that oral bacteria could increase weight gain by increasing appetite. The third hypothesis is that oral bacteria redirect energy metabolism by facilitating insulin resistance through increasing levels of TNF-α or reducing levels of adiponectin. Goodson et al. (2009), in which they found **one pathogen, *Selenomonas noxia*** also found in the periodontal biofilm, which at levels >1.05% of the total salivary bacteria, could identify obese individuals with high sensitivity and specificity,[8]. S. noxia belongs to the phylum Firmicutes, whose relative proportion of the gut microbiota has been reported to be elevated in obese individuals (Ley et al. 2006),[9]. By any of these mechanisms, even a small excess in calorie consumption with no change in diet or exercise could result in unacceptable weight gain.

Nine systematic reviews[Chaffee and Weston (2010),Suvan et al (2011),Moura-Grec et al (2014),Keller et al (2015), Li et al (2015),Akram et al (2016),,Gerber et al (2016),Nascimento et al (2016), Martens et al (2017),Martinez-Herrera et al (2017)]reported on the prevalence or extent and severity of periodontal complications in overweight or obese individuals. Two of these reviews[Li et al (2015), Martens et al (2017)]included studies solely of children and adolescents. Data from these 9 reviews show that obese individuals are more likely to have a form of periodontal disease than normal-weight individuals, independent of age or gender. Also, increasing levels of overweight through obesity are associated with more extensive and severe periodontitis,[10-19].

In our study, samples were stratified in two groups (obese and non-obese individuals) and the main focus of the study was to evaluate the correlation of BMI, BF% and WC with periodontal disease along with the role of other confounding factors like gender, oral hygiene status.

In large epidemiological studies, body mass index remains predictive of health risk (cardiovascular disease, cancer, and mortality), but it can be augmented by anthropometric measures of fat distribution.

In the present study, the prevalence of periodontitis was higher in obese subjects (68.5%) when compared to non-obese subjects (31.5%)and the prevalence of gingivitis was significantly higher in non-obese subjects (71.7%) as compared to obese subjects(28.3%).This result was in agreement with the studies published by AI-Zahrani *et al,*[20] and on the contrary Ylostalo et al, did not find any positive correlation between body weight and periodontal infection,[21].

In our study according to Body Fat Percentage (BF%), the result showed a significantly higher prevalence of periodontitis in obese male individuals as compared to non-obese male individuals and also a significantly higher prevalence of periodontitis in obese female individuals as compared to non-obese female individuals.

In the present study according to Waist Circumference(WC), the result showed a significantly higher prevalence of periodontitis in obese male individuals as compared to non-obese male individuals and on the contrary, the prevalence of periodontitis in obese female individuals as compared to non-obese female individuals is not statistically significant. This finding is consistent with the study conducted by Al-Zahrani *et al,*[20].

It has been estimated in longitudinal follow-up studies that individuals who are obese have a 35% increased risk of developing periodontitis compared with normal-weight individuals,[22]and the risk may be higher among women who are obese as compared with men who are obese,[23]. On the other hand, there is no indication yet that the response to periodontal treatment should differ for individuals who are obese versus individuals who are not,[24].

The prevalence of periodontitis was significantly higher in fair and poor oral hygiene group of obese participants as compared to the fair and poor oral hygiene group of non-obese participants. There is a dose-response relationship between Oral hygiene (OH) and periodontitis, with fair and poor OH significantly increasing the risk of having periodontitis by two and five-fold, respectively, compared with good OH,[25].

One of the main limitations of this study was data collection was confined to a small population, which might affect the generalizability of the study. Hence, studies with a larger population are recommended in the future. The prevalence of obesity varies according to age, gender, geographical environment, socio-economic status, etc. Since a cross-sectional design was adopted, it limits the ability to identify causality between obesity and periodontal disease, therefore, longitudinal study design will be required to explore cause and effect relationships in this regard. The dentist should take into account BMI, BF% and WC in their patient history so that they can refer their overweight and obese periodontal patient for weight reduction interventions like diet therapy, behavioral therapy, pharmacotherapy, and surgical procedures so that they can have better control over periodontal inflammation.

Furthermore, obesity spread can be explained by the evidence that environmental factors, such as lifestyle and nutrition, affect the epigenetic programming of parental gametes, the fetus, and the early postnatal development, so the epigenetic marks induced in-utero and in early life could determine a significant increase of obesity (and of other complex disease, such as type 2 diabetes (T2D) and cardiovascular disease) and could be transmitted transgenerationally. The identification of epigenetic alterations at the very beginning of obesity development is important to predict disease trajectories and to choose eventually the most effective therapy. The reversible nature of epigenetic modifications makes them attractive targets for a possible epigenetic therapy of obesity, in fact, growing evidence about the use of "epigenetic drugs" (compound able to interfere with epigenetic mechanisms) in the treatment of obesity are emerging,[26].

CONCLUSION

An emerging parallel concept in periodontology is personalized periodontics, which is aimed at real-time evaluation of disease activity and predicting therapeutic outcome and post-treatment stability,[27,28]. Personalized periodontics is an innovative approach that takes into account individual differences in people's genes, environments, lifestyle, and behavior. Personalized periodontal therapy would enable patients to receive the most effective and safe therapeutic agent as their first line of treatment, based on individual biomarkers (immunological, genetic or epigenetic). The benefit of such an approach could maximize clinical outcomes, cost-effectiveness, and patient satisfaction by accurately identifying a bespoke strategy for each particular patient,[29,30].

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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