Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Association between obesity and chronic periodontitis: A cross-sectional study

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Cite this paper as: Dr. Widam Chewang,Dr. Shalini Gupta, Dr. Amrinder Singh Tuli, Dr. Vaishnavi Prasad, Dr. Prerna Joshi, Dr. Vasundhara Tiwari (2025) Association between obesity and chronic periodontitis: A cross-sectional study *Journal of Neonatal Surgery*, 14 (32s), 1716-1729.

ABSTRACT

Background: Periodontitis is a prevalent chronic inflammatory disease influenced by bacterial pathogens and modulated by the host's immune response. Obesity, a global public health concern, is characterized by a chronic low-grade inflammatory state and has been implicated as a risk factor for several systemic diseases, including periodontitis. This study investigates the association between obesity and chronic periodontitis in an adult population.

Materials and Methods: A comparative cross-sectional study was conducted involving 459 patients aged 30–55 years. Participants were categorized into two groups based on Body Mass Index (BMI): Group A (BMI <24 kg/m²) and Group B (BMI ≥24 kg/m²). Periodontal health was assessed using Gingival Bleeding Index (GBI), Probing Pocket Depth (PPD), Clinical Attachment Level (CAL), and Community Periodontal Index for Treatment Needs (CPITN). Statistical analysis was performed using SPSS v21.0, with significance set at $p<0.05$.

Results: No significant difference was observed in GBI between the two BMI groups ($p=0.934$), indicating that gingival bleeding was not influenced by BMI. However, Group B (overweight/obese) demonstrated significantly higher mean values for PPD ($p=0.021$), CAL ($p=0.014$), and CPITN ($p=0.001$) compared to Group A, suggesting worse periodontal health and greater treatment needs among individuals with higher BMI. Correlation analysis revealed a weak but statistically significant association between age and CAL in Group B ($r=0.140$, $p=0.044$), while other periodontal parameters showed no significant correlation with age.

Conclusion: The findings indicate a significant association between obesity and increased severity of chronic periodontitis, as evidenced by higher probing pocket depth, clinical attachment loss, and treatment needs in obese individuals. These results underscore the importance of considering obesity as a modifiable risk factor in periodontal disease management and prevention strategies.

Keywords: *Obesity, Chronic periodontitis, Body Mass Index, Periodontal health, Inflammation, Risk factors, Association*

1. INTRODUCTION

Periodontitis is a chronic inflammatory disease driven by bacterial pathogens and is one of the most common oral infections worldwide (WHO 2004). The host response to periodontal pathogens represents a crucial determinant of the individual's susceptibility to periodontitis. Several pro-inflammatory molecules and processes implicated in the pathogenesis of periodontitis, including cytokines (e.g. Interleukin-IL-6), chemokines and T-cell function, could be altered by obesity. An

.altered inflammatory state such as that found in obese individuals could predispose individuals to increased periodontal tissue destruction.

Chronic periodontitis is multifactorial and numerous risk factors have been identified to contribute in the disease progression. The most well-established risk factors for chronic periodontitis include systemic diseases like diabetes mellitus (DM) environmental factors like tobacco smoking and genetic factors such as interleukin (IL)-1 composite genotype.[2]

Over the past few decades, obesity has become a significant worldwide health problem. The incidence of obesity and elevated Body Mass Index (BMI) has dramatically increased in most industrialized countries. Obesity is now recognized as a chronic disease with a multifactorial etiology that develops from an interaction of genotype and the environment. Obesity has been associated with many serious, life–treating medical conditions. Besides being a risk factor for cardiovascular diseases, type II diabetes and certain cancers, obesity has also been suggested to be risk factor for periodontitis.[3]

Obesity is a major public health concern in both developed and developing countries. It has been implicated as a significant risk factor for several conditions including diabetes, cardiovascular disease, hypertension, stroke, and osteoarthritis. From a public health perspective, obesity has been implicated in a substantial proportion of the global burden of these diseases.[4]

Obesity is seen to be a significant predictor of periodontal disease and insulin resistance appears to mediate this relationship. Furthermore, obesity is associated with high plasma levels of TNF-α and its soluble receptors, which in turn may lead to a hyper-inflammatory state increasing the risk for periodontal disease and also accounting in part for insulin resistance.[5]

Hence, this cross-sectional study attempts to examine whether there is an association between obesity and periodontal disease parameters.

Materials and Methods:

A cross sectional study was conducted on the study population consisting of 459 patients who were selected from dental patients attending the Department of Periodontology, Seema Dental College and Hospital, Rishikesh. Prior to start of the study, the ethical clearance was obtained from ethical committee of Seema Dental College and Hospital, Rishikesh. The patients who were willing to be enrolled in the study, signed the consent form. The demographic data included the age, sex, occupation, dental and medical history, diet, oral hygiene status, adverse habits, smoking status, parafunctional habits and family history, which were recorded by using a questionnaire. The height of the selected individuals were recorded in centimeters using a height scale (figure 6). The weight was measured in kilograms using a weight scale (figure 5). The waist circumference was measured at the maximum diameter around the waist of the individuals, in centimeters, using a measuring tape (figure 1).

The BMI was calculated by using the following formula:

BMI = weight in Kgs/height in meter square (Kg/m^2)

The periodontal status was assessed using William's periodontal probe at six sites per tooth (figure 4) and a WHO probe (figure 3).

Figure 1: Armamentarium & materials

Figure2: Diagnostic instruments used

Figure 3: Measurement of clinical parameters

Figure 4: Measurement of pocket depth

Figure 5: Measurement of patient weight

Figure 6: Measurement of patient height

Inclusion criteria: Patients of age 30-55 years including both genders were selected for the study and all subjects having > 20 natural teeth were included in the study.

Exclusion criteria: This study's exclusion criteria were as follows- Subjects who were on anti- . who had received periodontal management for at least 3 months before, physically handicapped and mentally disturbed subjects, pregnant women and lactating mothers, patients having underlying systemic conditions which could disturb the periodontal health.

Sample Size: A total of 459 patients were recruited for the study and divided into two groups based on BMI:

GROUP-A: Healthy BMI: <24kg/ m^2

GROUP-B: Overweight/ obese: ≥24kg/ m^2

Periodontal examination

The periodontal examination included the assessment of Gingival bleeding index (GBI), Probing pocket depth (PPD),

Clinical attachment level (CAL) and Community periodontal index for treatment needs (CPITN). All the measurements were recorded with the help of calibrated manual probes- University of Michigan 'O' probe with William's markings and WHO probe.

Statistical analysis: All the clinical parameters values thus obtained were then statistically analysed. Summarized data was presented using Tables and Graphs. The data was analysed by SPSS (21.0 version). Shapiro Wilk test was used to check which all variables were following normal distribution. For intergroup comparison of independent data, Independent t test was used. Level of statistical significance was set at p-value less than 0.05(*).

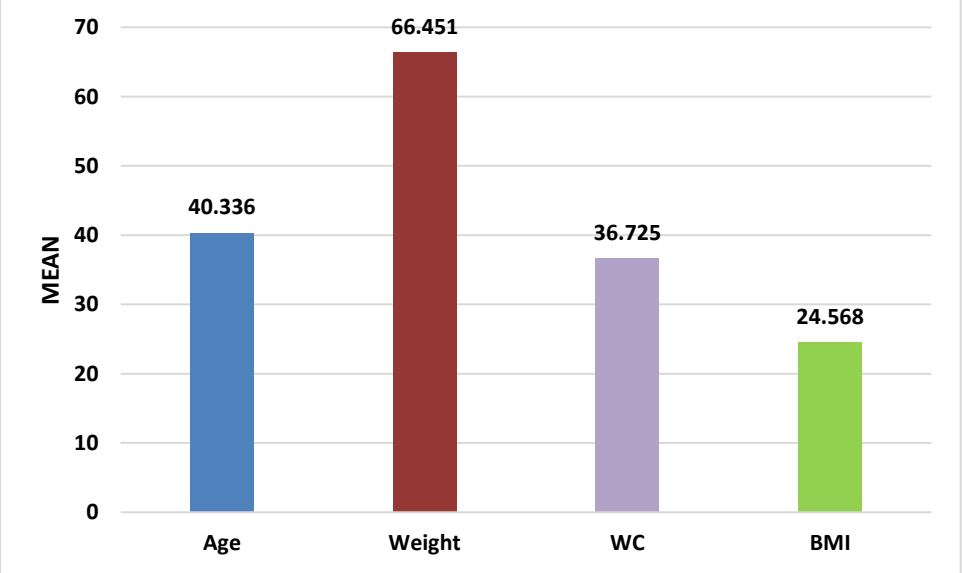
RESULTS:

The study was carried out to estimate the association between obesity and chronic periodontitis. 459 subjects were included in the study. The subjects were divided into two groups based on BMI- Group A (BMI<24) and Group B (BMI≥24). The clinical parameters assessed were gingival bleeding index, probing pocket depth, clinical attachment level, community periodontal index for treatment needs.

TABLE 1: DESCRIPTIVE OF STUDY SUBJECTS

	n	Minimum	Maximum	Mean	Std. Deviation
Age	459	30.0	59.0	40.336	7.3074
Weight	459	33.0	125.0	66.451	9.0114
WC	459	27.0	55.0	36.725	3.4386
BMI	459	2.0	45.0	24.568	3.5451

GRAPH 1: DESCRIPTIVE OF STUDY SUBJECTS



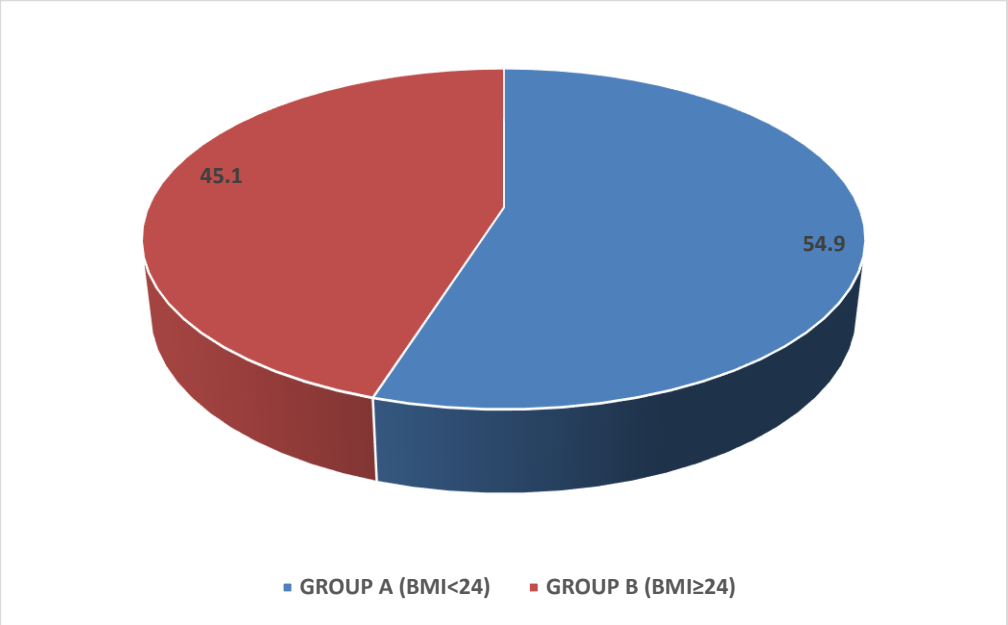
The demographic details of the participants enrolled for the study are summarized in Table 1.

This table provides an overview of the study population's characteristics, including age, weight, waist circumference (WC), and body mass index (BMI). The participants (N=459) had an age range of 30 to 55 years, with a mean age of 40.34 years (±7.31 SD). The weight ranged from 43 kg to 125 kg, with an average of 66.45 kg (±9.01 SD). The waist circumference (WC) varied between 27 cm and 55 cm, with a mean of 36.73 cm (±3.44 SD). BMI ranged from 2 to 45, with an average of 24.57 (±3.55 SD), indicating variations in body composition among the subjects.

TABLE 2: DISTRIBUTION OF STUDY SUBJECTS ACC TO BMI

		Frequency	Percent
BASED ON BMI	**GROUP A (BMI<24))**	252	54.9
	GROUP B (BMI≥24))	207	45.1
	Total	459	100.0

GRAPH 2: DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO BMI



Distribution of Study Subjects According to BMI (Table 2, Graph 2)

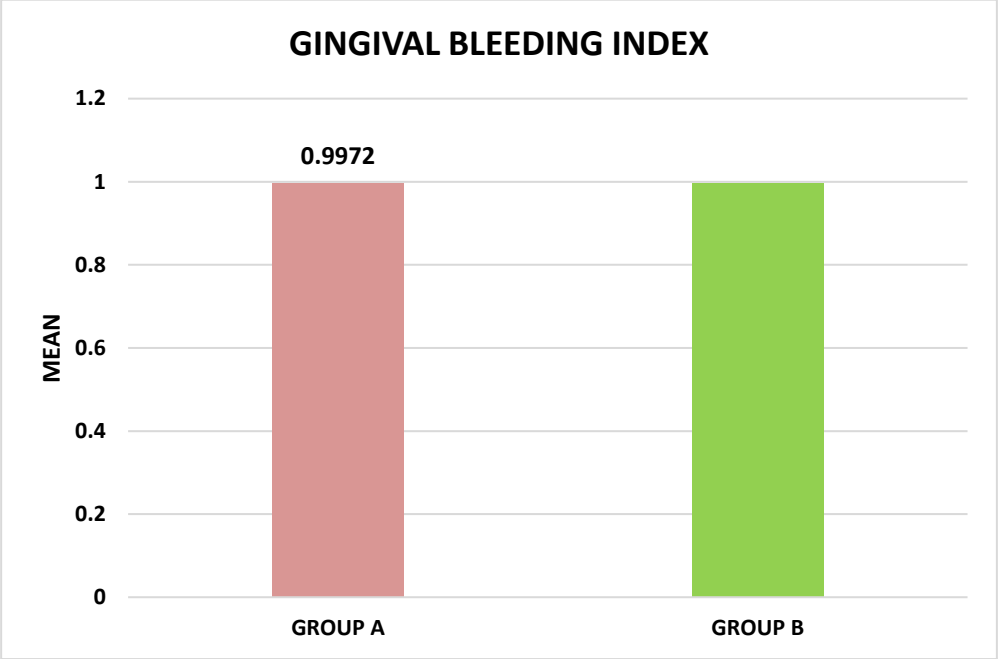
Group-A included 252 participants (54.9%), while Group-B comprised 207 participants (45.1%). This categorization helped in analyzing how different BMI levels impact various periodontal parameters.

CLINICAL PARAMETERS:

TABLE 3: INTERGROUP COMPARISON OF GBI

	GROUPS	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P-VALUE**
GBI	GROUP A	252	0.9972	0.13697	0.00863	0.934
	GROUP B	207	0.9963	0.08156	0.00567	

GRAPH 3: INTERGROUP COMPARISON OF GBI



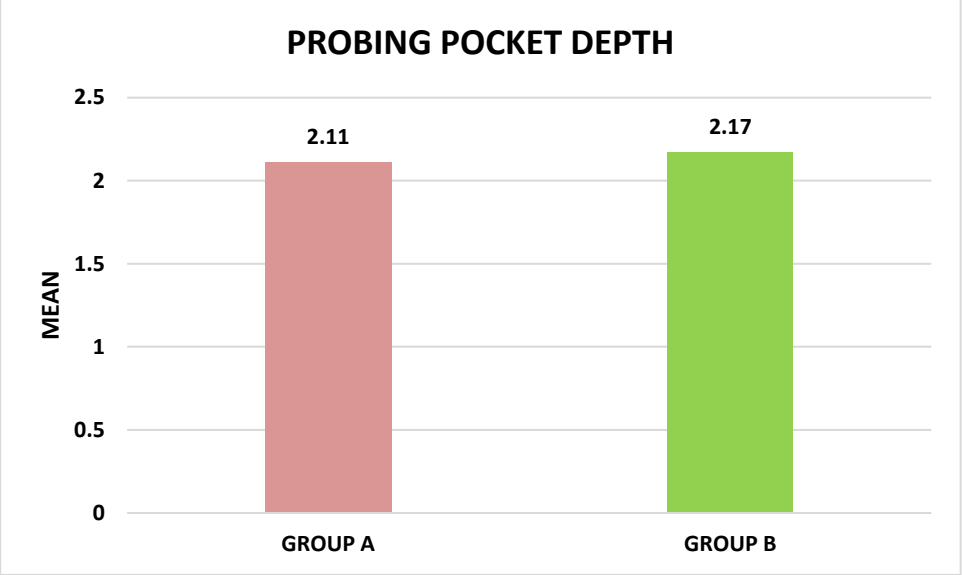
Intergroup Comparison of Gingival Bleeding Index (GBI) (Table 3, Graph 3)

The mean GBI for Group A was 0.9972 (±0.137 SD), whereas Group B had a mean GBI of 0.9963 (±0.082 SD). The p-value was 0.934, indicating that there was no statistically significant difference in gingival bleeding between the two BMI groups. This suggests that BMI does not have a significant impact on gingival bleeding in the studied population.

TABLE 4: INTERGROUP COMPARISON OF PPD

	GROUPS	N	Mean	Std. Deviation	Std. Error Mean	P - VALUE
PPD	**GROUP A**	252	2.116	0.26948	0.01698	0.021
	GROUP B	207	2.1773	0.22452	0.01561	

GRAPH 4: INTERGROUP COMPARISON OF PPD

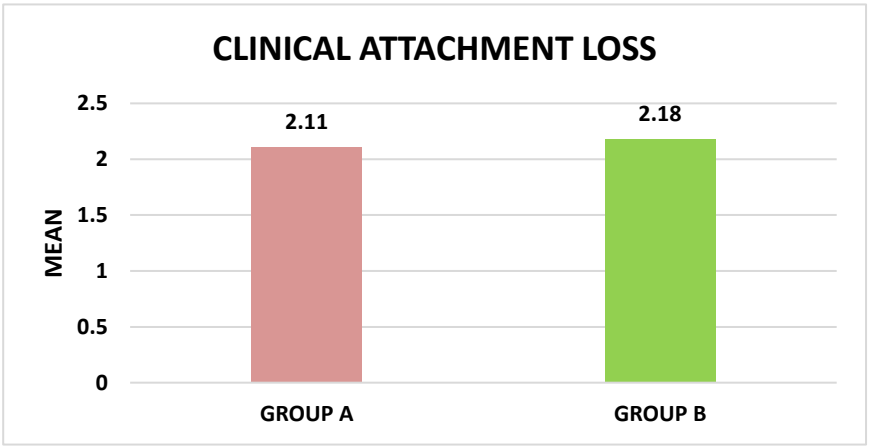


Inter-group Comparison of Probing Pocket Depth (PPD) (Table 4, Graph 4) The mean PPD in Group A was 2.116 mm (±0.269 SD), while Group B had a slightly lower mean PPD of 2.1773 mm (±0.225 SD). The p-value was 0.021, which indicates a statistically significant difference between the groups. This suggests that higher BMI may be associated with increase PPD.

TABLE 5: INTERGROUP COMPARISON OF CAL

	GROUPS	N	Mean	Std. Deviation	Std. Error Mean	P-VALUE
CAL	GROUP A	252	2.11048	0.272411	0.017160	0.014
	GROUP B	207	2.1843	0.264729	0.018400	

GRAPH 5: INTERGROUP COMPARISON OF CAL



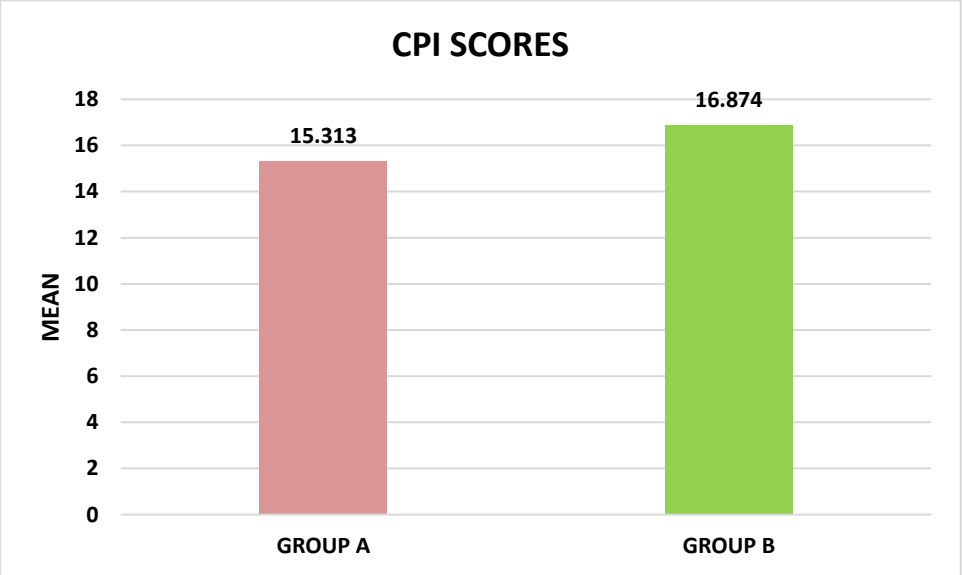
Inter-group Comparison of Clinical Attachment Loss (CAL) (Table 5, Graph 5)

The mean CAL for Group A was 2.1105 mm (±0.272 SD), whereas Group B had a mean CAL of 2.1884 mm (±0.265 SD). The p-value was 0.014, indicating a statistically significant difference in CAL between the groups. The findings suggest that individuals with a higher BMI may have a greater risk of attachment loss, possibly due to systemic inflammation and altered immune responses affecting periodontal structures.

TABLE 6: INTERGROUP COMPARISON OF CPI SCORES

	GROUPS	N	Mean	Std. Deviation	Std. Error Mean	P-VALUE
CPITN	GROUP A	252	15.313	5.4489	0.3432	0.001*
	GROUP B	207	16.874	7.3339	0.3707	

GRAPH 6: INTERGROUP COMPARISON OF CPI SCORES



Community Periodontal Index of Treatment Needs (CPITN) (Graph 6, Table 6)

The CPITN score was significantly higher in Group B (mean: 16.87 ±7.33 SD) compared to Group A (mean: 15.31 ±5.45 SD). The p-value was 0.001, indicating a highly statistically significant difference between the groups. This suggests that individuals with higher BMI had worse periodontal health, with greater treatment needs, possibly due to increased inflammatory responses associated with obesity.

TABLE 7: CORRELATION BETWEEN AGE AND PERIODONTAL PARAMETERS

		GBI	PPD	CAL	CPITN
Group A	Pearson Correlation	-0.092	-0.047	-0.052	0.028
	P VALUE	0.146	0.458	0.408	0.657

Group B	**Pearson Correlation**	0.073	0.124	0.140	0.033
	P VALUE	0.296	0.075	0.044*	0.640

The correlation between age and periodontal parameters (GBI, PPD, CAL, and CPITN) was analyzed separately for Group A and Group B using Pearson's correlation. In Group A, the correlation coefficients for GBI (-0.092), PPD (-0.047), CAL (-0.052), and CPITN (0.028) indicate very weak associations with age. Moreover, none of these correlations were statistically significant, as their p-values were greater than 0.05. Similarly, in Group B, weak correlations were observed for GBI (0.073), PPD (0.124), and CPITN (0.033), with p-values above 0.05, indicating no significant relationship. However, CAL in Group B showed a weak but statistically significant positive correlation with age ($r = 0.140$, $p = 0.044$), suggesting that as age increases, there is a slight increase in clinical attachment loss in this group. Overall, except for the significant correlation between age and CAL in Group B, no strong or significant associations were found between age and other periodontal parameters in either group.

2. DISCUSSION:

Periodontitis, a disease with multiple contributing factors, attacks the tissues that support teeth, such as the gums, periodontal ligament, and alveolar bone. This results in tooth loss and is significantly correlated with systemic conditions like cardiovascular disease, diabetes, and obesity. The pathogenesis of periodontitis is primarily driven by bacterial infection, but its progression is significantly influenced by host factors like immune responses, genetic predisposition, and environmental factors such as smoking and nutrition. Among these, obesity has garnered increasing attention due to its potential role in exacerbating periodontal disease.[6]

Obesity, defined by excessive body fat accumulation and often measured using the Body Mass Index (BMI), is associated with chronic low-grade inflammation. While a BMI of 24 or higher indicates overweight, obesity is clinically defined as a BMI of 30 or greater. This condition is linked to elevated levels of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α). These cytokines are not only implicated in the pathophysiology of systemic diseases but also in the inflammatory responses in the periodontium. This systemic inflammation may impair the body's ability to control periodontal infection, thereby accelerating the progression of periodontal disease.[7]

The link between obesity and the progression of periodontal disease is clinically significant. The impact of periodontitis extends beyond oral health, contributing to systemic complications. Moreover, the inflammatory burden associated with periodontitis can exacerbate insulin resistance, making it a critical factor in managing overall health.

This study aimed to explore the potential association between obesity and chronic periodontitis, particularly by comparing individuals with normal weight (Group A) and those classified as overweight or obese (Group B) based on BMI. By analyzing clinical parameters such as gingival bleeding index, probing pocket depth, clinical attachment loss, and community periodontal index for treatment needs, this study seeks to provide a clearer understanding of how obesity may influence the severity and treatment needs of periodontal disease.

Demographic data:

The demographic characteristics of the participants provide crucial context for interpreting the results of this study. A total of 459 participants were enrolled, with ages ranging from 30 to 55 years, and a mean age of 40.34 years (±7.31 SD). This age range is representative of an adult population, allowing for a comprehensive evaluation of how obesity might affect periodontal health in individuals beyond the typical adolescent or elderly age groups, where periodontitis is often more prevalent or influenced by other factors.

The participants exhibited a broad range of weights, from 43 kg to 125 kg, with an average weight of 66.45 kg (±9.01 SD). This variation in weight reflects the diversity within the study population and allows for an analysis of how weight might influence periodontal parameters, independent of other demographic factors. The weight distribution further emphasizes the importance of considering individual variations in body composition when examining the relationship between obesity and periodontitis.

The results of this study align with established research demonstrating a clear connection between obesity and worsened periodontal disease. Prior investigations have repeatedly shown that obesity intensifies inflammatory processes in the

periodontium, resulting in periodontal tissue breakdown. This systemic inflammatory state characterized by increased levels of proinflammatory markers like IL-6 and TNF-α, impair the body's ability to control periodontal pathogens effectively (**Graziani et al[8]).** In particular, the findings of this study which indicate that people with greater BMI have significantly higher levels of CAL and PPD, are consistent with the work of **Keller et al[9]**, which discovered a positive correlation between obesity and increased periodontal damage. Obesity-induced systemic inflammation can lead to the production of reactive oxygen species (ROS) and inflammatory mediators, which may increase tissue breakdown in the periodontal ligament and alveolar bone (**Jepsen S et al[10]**). The significant findings in PPD and CAL in Group B further support the hypothesis that obesity accelerates the inflammatory process in the periodontium, leading to deeper pockets and greater attachment loss.

Gingival Bleeding Index:

Our study found **no statistically significant difference** in the **Gingival Bleeding Index (GBI)** between different BMI groups (p=0.934). This suggests that while obesity may affect deeper periodontal structures, it doesn't appear to significantly alter superficial gingival bleeding. This could be because the obesity levels in our cohort weren't severe enough to induce substantial gingival inflammation. This aligns with **Lê S et al[11]** and **Maulani C et al[12]**, who noted that obesity's systemic inflammation more profoundly impacts deeper periodontal tissues like clinical attachment loss and probing pocket depth rather than superficial gingival signs.

In contrast, **Chisini LA et al[13]** reported a significant link between higher BMI and increased GBI, suggesting obesity can influence gingival inflammation. This discrepancy might stem from differing obesity levels or how systemic inflammation manifests in various periodontal tissues across study populations.

Probing Pocket Depth:

Our study revealed a **significant difference** in mean Probing Pocket Depth (PPD) scores between Group A and Group B (p=0.021), indicating that **higher BMI is associated with increased PPD**. This aligns with existing research by **Suvan J et al[14]** and **Al-Zahrani et al[4]**, who demonstrated a clear association between higher BMI and greater PPD. They suggest that obesity-induced systemic inflammation, driven by pro-inflammatory cytokines, contributes to the destruction of deeper periodontal tissues and the formation of deeper pockets, thus intensifying the severity of periodontal disease.

Clinical Attachment Loss:

Our study found a **significant difference** in mean Clinical Attachment Loss (CAL) scores between Group A and Group B (p=0.014), indicating that **higher BMI is associated with increased CAL**. This is consistent with findings from **Harris J et al[15]** and **Balistreri CR et al[16]**, who also reported a significant link between elevated BMI and CAL. Their research suggests that obesity-induced systemic inflammation and metabolic disruptions contribute to periodontal tissue degradation, leading to increased attachment loss, a critical indicator of periodontal disease severity.

Community Periodontal Index of Treatment Needs:

Our study found a **significant difference** in mean Community Periodontal Index of Treatment Needs (CPITN) scores between Group A and Group B (p=0.001). This indicates that **higher BMI is associated with increased CPITN scores,** suggesting a greater need for periodontal treatment. These findings align with research by **Kaye E et al[17]** and **Rathod V et al[18]**, both of whom observed a significant association between elevated BMI and higher CPITN scores, underscoring that obesity contributes to more severe periodontal disease and a greater demand for periodontal intervention.

3. CONCLUSION:

Within the scope of this study, it is possible to conclude that those with a higher BMI are more likely to develop periodontal disease. Strong evidence of a statistically significant correlation between obesity (as measured by a higher BMI) and important clinical markers of chronic periodontitis, such as deeper periodontal pockets, clinical attachment loss, and higher CPITN scores, is shown by the study's findings. These findings support the idea that obesity may play a part in the degree and severity of periodontal disease. The other metrics unequivocally show that a greater BMI has a detrimental effect on periodontal health, even if gingival bleeding was not considerably affected.

As a result, treating obesity might play an essential role in preventing and controlling periodontitis in the general population. Population health interventions focused at lowering obesity might thus play an important influence in improving oral health outcomes.

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