ORIGINAL ARTICLE

OPEN ACCESS

Assessing the Interrelationship of Obesity Indicators with Periodontal Health in a Cohort of Pakistani Population

Muhammad Mohsin Haider[1], Madiha Anwar[2], Kulsoom Fatima Rizvi[3], Arsalan Khalid[4], Maria Moin[5], Farzeen Tanwir[6]

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ABSTRACT

Objectives: Obesity is a growing public health concern worldwide, linked to various systemic diseases, including periodontitis. The study aims to evaluate the association between periodontitis and obesity using Body Mass Index and waist-hip ratio.

Materials and Methods: The study was conducted at Bahria University Dental College, recruiting 120 patients (72 females, 48 males) from the dental OPD. Participants were categorized into three groups based on their BMI: Normal, Overweight, and Obese. Periodontal parameters were measured and compared among these groups.

Results: It was observed that the majority of the obese subjects had PPD in the range of 0-3 mm while 9 of the obese subjects had pocket depth in the range of >3 mm and < 6 mm (p=0.02). The values of CAL were also observed more in obese subjects (p=0.01). The BOP was also positive in 23 obese subjects followed by 12 subjects in the overweight category (p=0.03). The calculus deposition and 4-5 mm pocket depth were also observed in 10 and 11 obese subjects, which is higher than the number observed in other groups (p<0.001). No statistically significant correlation between WHR was observed with PPD and BOP. However, CAL had a significant association with WHR (p=0.01). The correlation between CPI and WHR was also statistically significant (p=0.001).

Conclusion: The study demonstrates a positive association between markers of periodontal health and obesity. This suggests that obesity may be a potential causal factor in the development of periodontitis.

Keywords: Body-Mass Index, Obesity, Oral Health, Overweight, Periodontitis, Waist-Hip Ratio.

[1]Senior Lecturer, [3]Professor, [5]Assistant Professor and Head, Department of Community and Preventive Dentistry, Bahria University Medical and Dental College, Karachi, Pakistan

[2]Assistant Professor, Department of Oral Biology, Bahria University Medical and Dental College, Karachi, Pakistan

[4]Assistant Professor and Head, Department of Oral Medicine, Bahria University Medical and Dental College, Karachi, Pakistan

[6]Professor and Head, Department of Periodontology, Bahria University Medical and Dental College, Karachi, Pakistan

Corresponding author:

Madiha Anwar, Department of Oral Biology, Bahria University Medical and Dental College, Karachi, Pakistan. Email: madeeha.anwar@googlemail.com

INTRODUCTION

Obesity and periodontitis are among the common non-communicable diseases. Both these diseases are a growing epidemic that has affected a large population in developed countries as well as third-world countries like Pakistan.[1] Obesity is a condition that is a cause of many chronic inflammatory diseases such as Diabetes Mellitus type II, hypertension, hyperlipidemia, arteriosclerosis, cardiovascular disorders, and cerebrovascular diseases.[2] Due to the increased use of processed food and sedentary lifestyle obesity has increased drastically in the last few years.[3] In 2014, the World Health Organization (WHO) estimated that around 600 million obese adults worldwide were obese.[4] Nearly a third of the world's population is now classified as overweight or obese. The incidence of obesity has increased after the COVID-19 pandemic which has increased the preference of working from home. The body-mass index (BMI) and Waist Hip Ratio (WHR) are usually considered for the measurement of obesity. In Asian countries, the threshold of BMI classified as obese is lower, as the complications caused by obesity have been observed at comparatively lower BMI values.[5] This can be attributed to the diversity in culture, ethnicity, the geography of different regions, social and economic conditions, and degree of urbanization.

Obesity is associated with many systemic disorders and predisposes a person to a variety of dental problems as well.[6] It is considered a predisposing factor for periodontitis. Periodontitis is a prevalent oral condition in Pakistan that inflames the supporting tissues around the tooth and in severe cases leads to tooth loss.[7] The stimulation of the defensive host immune system damages the tissues leading to the synthesis and release of cytokines, proinflammatory mediators and metalloproteinases.[8] It has been reported that obesity modulates the host immune response which results in an increased susceptibility to infections.[9] Adipose tissues release certain pro-inflammatory cytokines, known as adipocytokines, which induce inflammatory processes and oxidative stress disorders. These adipocytokines can further trigger the inflammatory process in the periodontium and lead to delays in the wound healing process.[10] While existing studies have primarily explored the connection between obesity, increased BMI and periodontitis, this research uniquely contributes to the field by incorporating WHR as an additional parameter.[11] It has also been reported that

obesity, weight gain, overweight and large waist circumference may be a risk factor or maybe a worsening factor for periodontal disease and may also negatively impact the outcome of periodontal therapies.[12]

Obesity is a growing problem in Pakistan and the data assessing the relationship between obesity and oral health in the Pakistani population is very scarce.[13] Shah et al.[14] reported a significant correlation between increased BMI with increased clinical attachment loss (CAL).

It is important to assess this relationship between obesity and the progression of periodontal disease to control and limit the pathological changes in the periodontium at an early stage. The research question for this study is "Is there a significant association between obesity, measured by BMI and WHR, and the progression of periodontitis in a cohort of the Pakistani population." Therefore, this study aims to assess whether obesity is a risk factor for the development and progression of periodontitis in the Pakistani population and whether BMI and WHR can be used as reliable indicators of this relationship.

MATERIALS AND METHODS

The study was conducted in the Dental OPD of Bahria University Dental College (BUDC), Bahria University Health Sciences Campus (BUHSC), Karachi from March 2022 to August 2022. The study was approved by the Ethical Review Committee of BUHSC, Karachi (ERC: 16/2020). The design of the study was a cross-sectional analytical group comparative design. The sample size was calculated using Sample Size Software (PASS v 11.0). The probability for rejecting the null hypothesis (α) was 0.05 with the power of the study at 80%, type II error (β) was 0.20 and the expected correlation coefficient (r) was 0.35. The total sample size was calculated as 110 subjects. For this study, we have taken 120 subjects with 40 subjects in each group. The purposive sampling technique was employed. In this study, we established specific inclusion and exclusion criteria to ensure the relevance and reliability of our research findings. Inclusion criteria encompassed participants within the age range of 20 to 60 years who provided written informed consent and were in good systemic health. Furthermore, eligible participants had to possess a minimum of 10 teeth in their oral cavities and were categorized based on Body Mass Index (BMI), specifically as Normal (18-22.9 kg/m^2),

Overweight (23-25.9 kg/m^2), or Obese (>26 kg/m^2). Those falling within the third group exhibited a waist-hip ratio (WHR) exceeding >0.90 for males and >0.85 for females.

Participants who declined to participate were naturally excluded from the study, as were those with BMIs categorized as less than normal (<18kg/m^2). Additionally, individuals with uncontrolled systemic conditions such as diabetes, chronic renal failure, or hypertension were excluded, as were those who had taken antibiotics within the past 3 months or undergone periodontal treatment within the previous 6 months. Participants with fewer than 10 teeth in their oral cavities, a history of addiction, including smoking, areca nut, betel quid, naswar chewing, or those ladies who were pregnant or lactating, were also excluded. Lastly, individuals actively engaged in a weight loss program were not considered within the scope of this study.

Ethical approval was obtained from the Ethical Review Committee of Bahria University Health Sciences. The participants were recruited from the Department of Oral Diagnosis of the Dental OPD of BUDC. Patients were briefed about the aims and potential risks of the study. Participants fulfilling the eligibility criteria were recruited for the study and written consent was obtained. In the first stage of the study, a structured questionnaire consisted of three components. The first part consists of sociodemographic details e.g., age, gender, occupation, residence, and income. The socioeconomic status was determined based on the income of the family and occupation. The second part consists of medical and dental history and the third part consists of examinations i.e., BMI, WHR, clinical periodontal markers i.e., bleeding on probing (BOP), community periodontal index (CPI), clinical attachment loss (CAL) and periodontal pocket depth (PPD).

The examiners recorded the general sociodemographic details along with medical and dental history; followed by the calculation of BMI following the criteria for the South Asian population as normal weight (BMI: 18-22.9 kg/m^2), overweight (BMI: 23- 25.9kg/m^2), and obese (BMI >26kg/m^2) as well as WHR [WHR >0.90 (males), >0.85 (females)].[4] BMI was calculated using the formula body weight in kilograms (kg) divided by the square of the body height in meters (m^2) and was further confirmed by using the online Android application "BMI Calculator" (Appovo-Germany).

WHR was computed by dividing the waist measurement by the hip measurement (W/H). Body weight was measured using a digital weighing machine. Standing body height was measured from the shoulders in a relaxed posture with arms hanging freely, utilizing a measuring tape.

Intra-oral examination was performed, which involved assessing the presence or absence of bleeding on probing (BOP) within 10 seconds after probing, as well as recording clinical attachment level (CAL), Community Periodontal Index (CPI), and pocket probing depth (PPD). CAL and PPD were calculated using the WHO Periodontal Probe while CPI and BOP were evaluated using the CPITN probe. BOP was evaluated at six specific sites on each tooth in the oral cavity, excluding third molars, including the mesiobuccal, buccal, distobuccal, disto-lingual, lingual, and mesio-lingual sites. Before commencing the study, the researchers underwent calibration by conducting clinical periodontal measurements on a sample of 10 patients diagnosed with inflammatory periodontal disease (kappa = 0.85).

Data analysis was done by SPSS version 23. To assess data normality, the Shapiro-Wilk test was employed. Categorical variables were analyzed using the Chi-Square test, and correlations between BMI, WHR, and periodontal parameters were determined through Spearman's correlation analysis.

RESULTS

Table 1 shows the demographics of the study participants. There were more female participants (53.3%) as compared to males (46.6%). Most of the subjects belonged to middle socio-economic status (40%) and 38.8% of the subjects were educated up to graduate level.

Table 1: Descriptive statistics of the study participants

Gender	Frequency	Percentage
Male	63	46.60%
Female	87	53.30%
Socio-economic Status		
High	19	12.6%
Middle	55	36.6%
Low	76	50.6%
Education		
Secondary	54	36.0%
Intermediate	40	26.6%
Graduate	35	23.3%
Post-Graduate	21	14.0%

Table 2 includes the information about the dental history of the patients. It was observed that most of the subjects brushed either once (35.5%) or twice (43.33%) a day maintaining good oral hygiene. The frequency of dental visits in 50% of the subjects was greater than 6 months and the most frequent type of treatment was scaling and polishing.

Table 2: Dental History of the Patients

Brushing	Frequence	Percentage
No Brushing	11	12.22%
Once	32	35.55%
Twice	39	43.33%
Thrice	8	8.88%
Dental Visit		
Never	17	18.88%
Less Than 6 months	28	31.11%
Greater than 6 months	45	50%
Dental Treatment		
Scaling/Polishing	45	50%
Extractions	8	8.88%
Tooth Fillings	17	18.88%
None	20	22.22%

Table 3 shows the BMI, WHR and periodontal parameters of the subjects. The subjects were equally divided into 3 groups based on their BMI. The WHR was low in 35.5% of the subjects and high in 33.3% of the subjects. The PPD of 61.1% of the subjects was in the range of 0-3 mm while 22.2% had PPD >6mm. The CAL in 54% of the subjects was in the range of 0-3 mm and 26.6% of the subjects had CAL in the range of 4-5mm. BOP was present in 53.3% and absent in 46.6% of the subjects. The CPI values showed that 24.4% of the subjects had healthy periodontium while 22.2% of the subjects had a pocket depth of 4-5 mm. Bleeding and

calculus deposition was observed in 15.5% and 14.4% of the subjects respectively.

Table 4 shows the correlation of BMI and WHR with the periodontal parameters of the subjects. A statistically significant correlation was observed in all the periodontal parameters which shows that periodontal parameters are affected by weight gain.

Table 3: Descriptive statistics of BMI, WHR and periodontal parameters

Body-Mass Index (BMI)		
Normal	50	33.33%
Overweight	50	33.33%
Obese	50	33.33%
Waist to Hip Ratio (WHR)		
Low	52	35.55%
Moderate	48	31.11%
High	50	33.33%
Periodontal Probing Depth (PPD)		
0-3 mm	55	36.6%
>3mm-<6 mm	45	30.0%
>6mm	50	33.3%
Clinical Attachment Loss (CAL)		
0-3 mm	49	32.6%
4-5 mm	57	38.0%
6-8 mm	44	29.3%
Bleeding on Probing (BOP)		
Present	78	53.33%
Absent	72	46.66%
Community Periodontal Index (CPI)		
Healthy	57	14.44%
Bleeding	53	15.55%
Calculus	68	24.44%
4-5 mm Pocket	36	22.22%
>5 mm Pocket	33	13.33%

Table 4: Correlation between BMI, WHR and Periodontal Parameters

		BMI	WHR	PPD	CAL	BOP	CPI
Spearman's correlation	**BMI**	1.000	.517**	.316**	.390**	-.321**	.518**
	WHR	.517**	1.000	.299**	.318**	-.204*	.510**
	PPD	.316**	.299**	1.000	.809**	-.315**	.659**
	CAL	.390**	.318**	.809**	1.000	-.300**	.761**
	BOP	-.321**	-.204*	-.315**	-.300**	1.000	-.661**
	CPI	.518**	.510**	.659**	.761**	-.661**	1.000

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

The current study evaluated the periodontal parameters and studied their relationship with obesity in a sample of the Pakistani population which was measured using BMI and WHR. The subjects were selected from the patients reporting to the Department of Periodontology of Bahria University Dental College. Obesity is a known factor for causing chronic periodontitis but the causal relationship between obesity and periodontitis is unknown. It is believed that the adverse effects of obesity on periodontium may be caused by impaired glucose metabolism, hyperlipidemia or increased levels of inflammatory molecules secreted by adipose tissues. Tumour necrosis factor-alpha mediates the endotoxin injury in periodontal tissues. Adipose tissues release many of these molecules which can be a potential cause of damaging the periodontium leading to inflammation. TNF-alpha has also been reported to generate insulin resistance in body cells. Therefore, it can be considered a potential cause of periodontal inflammation. The prevalence of obesity in Pakistan is increasing with a sedentary lifestyle and the use of fast food. Particularly, since the onset of the pandemic and the increase in the tendency of the "work-from-home" policy of many companies has further increased the incidence of obesity in people. BMI is reported to be the most common parameter for evaluating obesity. However, it considers height and does not give a true picture of body fat. Waist circumference and WHR help in determining abdominal adiposity. The upper abdominal fat is considered more detrimental in comparison to lower body fat. Therefore, both parameters were considered for this study. The results of the current study show a strong association between the presence of periodontitis and obesity. The PPD was measured in all the subjects, and it was observed that severe PPD was present in overweight and obese subjects. A higher prevalence of periodontitis in obese subjects has been reported in different populations such as Japanese,[15] Koreans,[16] and Iraqi[17] population as well. The severity of pocket depth statistically significantly increased in overweight and obese subjects. This is also in line with other studies which observed severe PPD in obese and overweight subjects. Thomas et al. however reported no association between obesity and periodontitis.[18] Similar results have been observed in subjects with high and moderate WHR. The severity of periodontitis was statistically significantly associated with increased WHR. The findings were in line with the results of Ganesan et al. who also reported that high WHR is associated with an increased prevalence of obesity.[19]

The CAL was also measured, and it was observed that moderate and severe CAL were present in overweight and obese subjects while the normal individuals had limited or mild CAL. CPI also indicates severe periodontitis in obese subjects. Moderate CAL was observed in subjects having moderate and high WHR. The CPI index also showed a statistically significant association with obese and overweight subjects and subjects having moderate to high WHR. These findings are in accordance with many other studies which confirm that obese subjects are more prone to periodontitis and the severity may increase with increased body fat.

Chachar et al. also reported that overweight and obese subjects are prone to periodontal diseases and the prevalence is quite high in female obese subjects.[20] Mazhar et al.[21] and Ataullah et al.[22] also established a positive association between obesity and periodontal health of the subjects' particularly old obese subjects are strongly influenced. A recent study conducted in a tertiary care hospital in Karachi established a significant positive correlation between BMI and the severity of periodontitis.[23]

Different clinical trials have been conducted to evaluate the effect of obesity on non-surgical periodontal treatment. Martinez et al.[24] Peralta et al.[25] and Osagbemiro et al.[26] reported that a negative effect is exerted on the non-surgical periodontal treatment outcomes in obese subjects.

In this study, we did not consider many other factors such as gender, age, smoking status and other risk factors which lead to periodontitis. This study was a single-center study which is another limitation. The sample size was also small. Further studies need to be conducted which should be multicentered, with a larger sample size and considering other risk factors that can lead to periodontitis. Other indices should also be used to indicate the presence and severity of periodontitis. Randomized controlled trials should also be undertaken to determine the effect of obesity and WHR on periodontal inflammation and treatment.

CONCLUSION

In conclusion, this study found a strong association between obesity and periodontitis in the Pakistani population, as assessed by BMI and WHR. The severity of periodontal issues, including pocket probing depth (PPD), clinical attachment level (CAL), and the Community Periodontal Index (CPI), was notably higher in overweight and obese subjects. This research sheds light on the relationship between obesity and periodontitis, however, multicenter studies with larger sample sizes and consideration of additional risk factors are needed for a more comprehensive understanding. Randomized controlled trials would also help clarify the impact of obesity and waist-hip ratio on periodontal inflammation and treatment outcomes.

DISCLAIMER

None.

CONFLICT OF INTEREST

None to declare.

ETHICAL STATEMENT

Ethical approval was obtained by the Ethical Review Committee of Bahria University of Health Sciences (ERC number: 16/2020) according to the Declaration of Helsinki.

AUTHORS CONTRIBUTION

Conception and design of the study: M. Anwar

Acquisition of data: M.M. Haider, F. Tanwir

Analysis and interpretation of data: K. F. Rizvi, A. Khalid

Drafting of the manuscript: M. Anwar, M. Moin

Critical review of the manuscript: M. Anwar, F. Tanwir

Approval of the final version of the manuscript to be published: M.M. Haider, M. Anwar, K.F. Rizvi, A. Khalid, M. Moin, F. Tanwir

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