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ORIGINAL RESEARCH

Association between Obesity and Chronic Periodontitis: A Cross-sectional Study

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ABSTRACT

Aim: Chronic periodontitis is multifactorial and numerous risk factors have been identified to contribute in the disease progression. Current study aimed to conduct a cross-sectional study in a population of patients with cardiovascular diseases in order to correlate the association between obesity [body mass index (BMI) and waist circumference (WC)] and periodontal disease parameters.

Materials and methods: The study was of a cross-sectional design and a total of 201 patients were examined after obtaining their informed consent. Subjects who had a history of cardiovascular diseases and under treatment were included in the study. Two indicators of obesity were used: BMI and WC. The following periodontal parameters were assessed: Probing depth, clinical attachment level. The oral hygiene status of the subjects was assessed by the oral hygiene index (OHI, simplified) given by John C Greene and Jack R Vermillion. The influence of the BMI and other confounding variables on periodontitis severity was assessed by multivariate logistic regression analysis. Data were analyzed using SPSS.

Results: Significant association was seen with low density lipoproteins (LDL) and severity of periodontitis ($p < 0.005$), triglyceride levels (TGL) and severity of periodontitis ($p < 0.005$), cholesterol and severity of periodontitis ($p < 0.005$), BMI and severity of periodontitis ($p < 0.001$), OHI and severity of periodontitis ($p < 0.001$). Significant association was seen with smoking and severity of periodontitis ($p < 0.005$), BMI and severity of periodontitis ($p < 0.001$), WC and severity of periodontitis ($p < 0.001$), cholesterol and severity of periodontitis ($p < 0.001$), OHI and severity of periodontitis ($p < 0.001$).

Conclusion: Obesity has been implicated as a risk factor for several conditions including cardiovascular disease, diabetes, etc. In our study the relation between measures of overall and abdominal obesity (BMI and WC) and periodontal disease showed significant association in the multivariate logistic regression analysis independent of other confounding factors.

Clinical significance: Obesity can act as a significant risk factor in progression of periodontitis.

Keywords: Cross-sectional study, Chronic periodontitis, Body mass index, Waist circumference, High density lipoproteins, Low density lipoproteins, Obesity.

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INTRODUCTION

Chronic periodontitis is a chronic inflammatory condition affecting the supporting structures of the teeth. The disease has a specific microbial etiology. The microbial challenge posed by the subgingival plaque biofilm elicits an immune response in the host which results in the progressive destruction of the periodontal ligament in alveolar bone resulting in pocket formation and tooth mobility.

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)[1] environmental factors like tobacco smoking[2] and genetic factors such as interleukin (IL)-1 composite genotype.[3]

Of late, obesity has been examined as risk element for periodontal disease progression in young and middle aged adults.[4] Obesity and overweight are defined as accumulation of excess body fat, to an extent that may impair health.[5] A high body mass index (BMI) has been found to be a major risk factor for a number of diseases including cancer, cardiovascular diseases and DM.

Biologically plausible mechanisms that connect obesity and periodontal diseases have been suggested. Shimomura et al[6,7] have shown that the visceral adipose tissue acts as an organ that secretes important bioactive substances termed adipocytokines (which include TNF-alpha) which may affect periodontal disease pathogenesis.

A recent study by Lundin et al[8] has shown that in a population young adults, TNF-alpha levels in gingival crevicular fluid correlate with BMI in individuals with BMI greater than 40. The author suggested that obesity is type of low grade systemic inflammatory disease with potential for effecting periodontal disease progression.

With the available background information, we aimed to conduct a cross-sectional study in a population of patients with cardiovascular diseases in order to correlate the association between obesity [BMI and waist circumference (WC)] and periodontal disease parameters.

AIMS AND OBJECTIVES

Aims

The aim of the study is to find out and correlate the association between obesity (BMI and WC) and chronic periodontitis in patients with cardiovascular disease.

Objectives

- To assess whether obesity is a risk factor for chronic periodontitis
- To find out the correlation between the cardiovascular risk parameters (age, smoking, lipid profile, diabetes status) and chronic periodontitis.

MATERIALS AND METHODS

All patients were recruited from Sri Ramachandra Cardiac Care Centre, Sri Ramachandra University.

The study was of a cross-sectional design and a total of 201 patients were examined after obtaining their informed consent. Subjects who had a history of cardiovascular diseases and under treatment were included in the study.

Data collection: A thorough medical, dental, personal, family and drug history was elicited. Data regarding the lipid profile: Low density lipoproteins (LDL), high density lipoproteins (HDL), triglyceride levels (TGL), total cholesterol, diabetic status (either random blood glucose or fasting blood glucose) was obtained from the medical records available with the patients. Alcohol consumption and smoking status were recorded by distributing questionnaires.

The height of the selected individuals was recorded in centimeters using a height scale. The weight was measured in Kilograms using a weight scale. The WC was measured at the maximum diameter around the waist of the individuals, with a measuring tape, in centimeters.

Periodontal status and oral hygiene assessment: The periodontal status was assessed by a single examiner using a William's periodontal probe; at six sites per tooth 7 the measurements were rounded off to the nearest millimeter. Third molars and root stumps were not included in the study. The following periodontal parameters were assessed: Probing pocket depth, clinical attachment level.

The oral hygiene status of the subjects was assessed by the oral hygiene index (OHI, simplified) given by John C Greene and Jack R Vermillion.[9]

Obesity assessment: Two indicators of obesity were used: BMI and WC. The overall obesity of subject was determined by the calculating BMI. The BMI was calculated by using the following formula:

$$\text{BMI} = \text{weight in Kgs/height in meter square (Kg/m}^2\text{)}$$

The subjects were divided into two groups based on BMI as follows:[10] Healthy BMI: <24 Kg/m^2; overweight/obese: >20 Kg/m^2.

The WC gave an indication of the visceral adiposity/upper body mass obesity. The subjects were divided into two categories, with cutoff values as 85 cm for men and 80 cm for women.[10]

Periodontitis severity: Clinical attachment loss of 5 mm or more at five or more sites was selected as a characterize periodontitis. The subjects were placed in two groups, low threshold and high threshold periodontitis based on the above mentioned criteria.[11]

Low threshold criteria: 5 or more sites <5 mm. High threshold periodontitis: Criteria: 5 or more sites >5 mm. Following data collection and clinical examination, the 201 patients were categorized into two groups for all the confounding variables based on certain cutoff values.

Statistical analysis: The influence of the BMI and other confounding variables on periodontitis severity was assessed by multivariate logistic regression analysis. Data were analyzed using SPSS. In all multivariate analysis, adjustments were for age, gender, diet, smoking status, alcohol, history of diabetes. In the logistic regression models for goodness-of-fit, the following variables were recoded: Gender was recoded as male (Code 1) and female (Code 2), history of diabetes (yes: Code 1, no: Code 2) and current smoking history (yes: Code 1, no: Code 2), oral hygiene status (good and fair: Code 1, poor: Code 2), BMI (normal: Code 1, abnormal: Code 2); similarly for WC, periodontitis severity (low threshold: Code 1, high threshold: Code 2).

RESULTS

Demographic Variables of the Sample Population

A total of 201 patients, 169 males (84.1%) and 32 females (15.9%) were included in the study. The mean age of the patients was 57.24 years (Table 1).

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Standard deviation
Age in years valid N (list-wise)	201	30	75	57.24	9.41

Among 201 patients (Table 2), 65 patients (32.3%) were smokers and 136 (67.7%) belonged to the former and nonsmokers group. Alcohol consumption was affirmative in 28 patients (13.9%). When the diabetic status was assessed, 105 patients (51.7%) were found to be diabetic. The lipid profile showed 100 patients (49.8%) with abnormal HDL, 120 patients (59.7%) with abnormal LDL, 92 patients (45.8%) with abnormal TGL and 68 patients (33.8%) with abnormal cholesterol. The oral hygiene in 131 patients (65.2%) was fair and poor in 78 patients (34.8%). The BMI score showed 166 patients (82.6%) to be obese. Assessment of the WC showed high WC in 151 out of 169 men (89.3%) and high WC in all the 32 women (100%) examined.

Multivariate Logistic Regression Analysis

Multivariate logistic regression analysis was carried to obtain an association between measures of obesity (BMI and WC) and severity of periodontitis taking into consideration the following confounding variables: Age, sex, diet, smoking, alcohol consumption, diabetes, lipid profile and oral hygiene status. Significant association was seen with LDL and severity of periodontitis ($p < 0.005$), TGL and severity of periodontitis ($p < 0.005$), cholesterol and severity of periodontitis ($p < 0.005$), BMI and severity of periodontitis ($p < 0.001$), OHI and severity of periodontitis ($p < 0.001$) (Table 3).

Since, all the 32 women examined were obese and belonged to nonsmokers group multivariate analysis was carried out in 169 men to see the association of BMI, WC and smoking with the severity of periodontitis independent of the other confounding factors. Significant association was seen with smoking and severity of periodontitis ($p < 0.005$), BMI and severity of periodontitis ($p < 0.001$), WC and severity of periodontitis ($p < 0.001$), cholesterol and severity of periodontitis ($p < 0.001$), OHI and severity of periodontitis ($p < 0.001$) (Table 4).

Table 2: Frequency distribution of the variables in the study

Variables		Frequency	Percentage
Sex	Male	169	84.1
	Female	32	15.9
Diet	Mixed	166	82.6
	Vegetarian	35	17.4
Smoking	Yes	65	32.3
	No	136	67.7
Alcohol	Yes	28	13.9
	No	173	86.1
Diabetes	Yes	105	51.7
	No	96	48.3
HDL	Normal	101	50.2
	Abnormal	100	49.8
LDL	Normal	81	40.3
	Abnormal	120	59.7
TGL	Normal	109	54.2
	Abnormal	92	45.8
Cholesterol	Normal	133	66.2
	Abnormal	68	33.8
BMI	Normal	35	17.4
	Obese	166	82.6
OHI score	Fair	131	65.2
	Poor	70	34.8
Periodontitis	Low	78	38.8
	High	123	61.2
WC men	Normal	18	10.7
	High	151	89.3
WC women	High	32	100
Age (in years)	Below 60	111	55.2
	Above 60	90	44.8

DISCUSSION

The emergence of periodontal medicine has shed light on the link between oral health and systemic health. Growing evidence show periodontal disease to be associated with various systemic diseases like coronary heart disease (CHD), DM and preterm low birth weight, etc. Obesity one of the most significant health risk in today's world is recognized as a chronic disease with multifactorial etiology. Obesity is identified as either an independent or an aggravating factor for a number of diseases such as hypertension, CHD, type II DM. Recent studies indicate the common link between DM, obesity, CHD and periodontal disease as inflammation. Thus, we set out to investigate the association between the obesity and periodontal disease in Indian population using BMI and WC as measures of overall and abdominal fat respectively. This study was conducted on a cardiovascular cohort under treatment. The findings of our study showed significant association between obesity severities of periodontal disease among individuals aged 30 to 75 years.

The multivariate logistic regression analysis for 201 patients was performed and BMI was positively associated with the severity of periodontitis ($p < 0.01$). Our study is in concordance with Linden et al,[12] who examined participants in prospective epidemiological study of myocardial infarction (PRIME) in a European population and reported obesity (BMI > 30 Kg/m^2). Increased odds of having low-threshold periodontitis by 77%.

Our study also concurs with other epidemiological studies like Buhlin et al,[13] who showed BMI > 25 in women

Table 3: Multivariate logistic regression analysis (201 patients) variables in the equation

	B	*SE*	*Wald*	*df*	*Sig.*	*Exp (B)*	*95.0% CI for Exp (B)*	
							Lower	*Upper*
Step 1 age	0.034	0.019	3.104	1	0.078	1.035	0.996	1.074
Sex	0.095	0.528	0.032	1	0.858	1.099	0.391	3.093
Diet	–0.339	0.468	0.525	1	0.469	0.712	0.284	1.783
SM	–0.486	0.489	0.987	1	0.32	0.615	0.236	1.605
Alcohol	–0.505	0.636	0.631	1	0.427	0.603	0.173	2.100
DM	–0.414	0.349	1.401	1	0.237	0.661	0.333	1.312
HDL-1	–0.565	0.419	1.815	1	0.178	0.569	0.250	1.293
LDL-1	1.124	0.503	5.000	1	0.025	3.079	1.149	8.249
TGL-1	0.796	0.393	4.094	1	0.043	2.216	1.025	4.790
CHOL-1	–1.117	0.489	5.224	1	0.022	0.327	0.126	0.853
BMI 1	2.253	0.496	20.663	1	0.000	9.519	3.603	25.151
OHI	1.925	0.444	18.822	1	0.000	6.854	2.873	16.354
Constant	–5.946	2.180	7.439	1	0.006	0.003	–	–

Table 4: Multivariate logistic regression analysis (169 men) variables in the equation

	B	*SE*	*Wald*	*df*	*Sig.*	*Exp (B)*	*95.0% CI for Exp (B)*	
							Lower	*Upper*
Step 1 age	–0.003	0.025	0.010	1	0.919	0.997	0.950	1.047
Diet	–1.095	0.607	3.255	1	0.071	0.335	0.102	1.099
SM	–1.210	0.576	4.411	1	0.036	0.298	0.096	0.922
Alcohol	0.073	0.686	0.011	1	0.916	1.075	0.280	4.126
DM	–1.087	0.449	5.871	1	0.015	0.337	0.140	0.812
HDL-1	–0.474	0.471	1.013	1	0.314	0.623	0.247	1.566
LDL-1	0.847	0.619	1.872	1	0.171	2.332	0.693	7.845
TGL-1	0.740	0.465	2.528	1	0.112	2.096	0.842	5.218
CHOL1	–1.885	0.588	10.298	1	0.001	0.152	0.048	0.480
BMI 1	2.654	0.591	20.199	1	0.000	14.212	4.467	45.217
OHI	3.155	0.681	21.441	1	0.000	23.452	6.169	89.155
WC	2.400	0.874	7.533	1	0.006	11.021	1.986	61.166
Constant	–7.107	2.987	5.660	1	0.017	0.001	–	–

to be associated with periodontitis in a group of individuals aged 36 to 70 years. According to study by Nishida et al, 120 individuals were found with BMI > 26 to be significantly associated with periodontitis in adults aged 20 to 59 years and Saito et al[14] who estimated the relative risk of periodontitis was 3.4 in persons with BMI of 25 to 29 Kg/m^2 and 8.6 in those with BMI above 30 Kg/m^2 in healthy 241 Japanese women. However, majority of the reports of association between BMI and periodontitis are primarily based on analysis of Japanese population[14-16] and USA data from Third National Health and Nutrition Examination Survey.[4,17] In all these studies variability exists in definition of the periodontal disease. Though BMI is a measure of overall adiposity, it does not assess body fat distribution. Moreover, older persons tend to have a higher fat composition and therefore risk assessment by BMI is less accurate. Therefore WC and waist to hip ratio (WHR) shows a closer correlation with the amount of visceral adipose tissue. Saito et al[18] and Woods et al[17] have shown significant correlation between WHR and periodontitis.

In this study we have taken WC into consideration and the multivariate logistic regression for 169 men showed strong association between high WC and severity of periodontal disease ($p < 0.01$). Men with high WC (>85 cm) had 9.5 times greater odds of having severe periodontal disease than those with normal WC (<80 cm). Women were excluded from the regression analysis as all the 32 women examined were obese. Our study shows association between WC and periodontal disease in the middle and older age group, whereas Al-Zahrani et al[4] in his study found significant correlation between WC and prevalence of periodontal disease in the younger age group (18-34 years) and not with the middle and older age group (60-90 years). Similarly Reeves et al[19] reported that adolescents with age 17 to 21 years were at an increased risk of periodontal disease per 1 cm increase in WC (adjusted odds ratio: 1.05). Since cardiovascular disease is more prevalent in adults, our study included only the middle and older age group and not the younger age group.

An increase in WHR is said to be a predictor of hepatic steatosis independent of BMI.[20] Saito et al[21] has shown positive association between serum aspartate aminotransferase, alanine aminotransferase, cholinesterase levels and aspartate aminotransferase to alanine

aminotransferase ratio and periodontitis, suggesting subjects with periodontitis also tend to have hepatic steatosis. Therefore it is reasonable to speculate visceral fat, which leads to hepatic steatosis, mat also increase the risk of periodontitis. Moreover, visceral adipose tissue has been shown to be metabolically more active and to secrete greater amounts of cytokines and hormones compared with subcutaneous adipose tissue.[22] The adipocytokines, TNF-alpha and IL-6 may enhance periodontal degradation. TNF-alpha in gingival crevicular fluid has been positively correlated with BMI in subjects with BMI > 40.[12]

Among the 201 patients the lipid profile parameters (LDL, total cholesterol and TGL showed a statistical association with the severity of periodontitis $p < 0.05$). Association of hyperlipidemia and periodontitis has been shown in several animal models and human epidemiological studies. Our study is in agreement with that of Losche et al,[23] who reported that total cholesterol, LDL and TGL were significantly higher in subjects with periodontal disease. Katz et al[24] in a study of subjects classified as having CHD and hypercholesterolemia, showed a significant association between high community periodontal index for treatment needs scores and periodontal disease. From the results of our study and other epidemiological data, it is plausible that periodontal disease and cardiovascular disease share hyperlipidemia as a common risk factor.

The relationship between severity of periodontitis and smoking was assessed in 169 men only as all the women examined (32) were nonsmokers and statistically significant association was seen ($p < 0.05$). Increasing evidence points to smoking as a major risk factor for periodontitis affecting in the prevalence, extent, severity of disease as well as influencing the clinical outcome of nonsurgical and surgical therapy. It has been shown that smokers have higher level of periodontitis regardless of oral hygiene,[25,26] deeper probing depths and larger number of deep pockets,[27,28] more attachment loss including more gingival recession[29,30] and increased alveolar bone loss.[31] Smoking is associated with increased severity of periodontal disease in younger individuals[32] as well as in older adults.[33] Thus, the result of our study is consistent with the findings of other studies, demonstrating the detrimental effect of smoking on severity of periodontitis.

A total of 105 were diabetic among the 201 patients and 88 were diabetic among the 169 men. Association between severity of periodontitis and diabetes ($p < 0.05$) was noted in 169 men whereas statistical significance was not evident in 201 patients. One possible explanation could be that all the diabetic patients were under oral hypoglycemic medication or under insulin therapy for a prolonged period. Our result is also in agreement with a study by Saito et al,[34] on relation between obesity, glucose tolerance and periodontal disease in Japanese women. He showed that oral glucose tolerance results were closely associated with both periodontal condition and obesity but the relationship between the obesity indices and deep pockets was more significant than that between the oral glucose tolerance test results and deep pockets and later was not significant in multivariate models. He suggested that the obese condition is associated with periodontal disease independent of deteriorated glucose condition.

Thus, the results of the study show an association between obesity and severity of periodontitis after adjustment for possible confounders. Therefore, prevention and management of obesity can be an adjunctive approach for improving periodontal health.

CONCLUSION

Obesity has been implicated as a risk factor for several conditions including cardiovascular disease, diabetes, etc. In our study the relation between measures of overall and abdominal obesity (BMI and WC) and periodontal disease showed significant association in the multivariate logistic regression analysis independent of other confounding factors. Thus, an increased focus on prevention, in individuals at risk of developing obesity may benefit both general and oral health.

CLINICAL SIGNIFICANCE

In the era of evolving periodontal medicine considering various factors affecting the development of chronic periodontitis has become a two-way process. Current study throws light on the association of obesity and chronic periodontitis. Giving due importance to patients obesity status and controling it can add up to the treatment outcomes. Still long-term longitudinal studies are required to further validate.

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