Association between Periodontal Status, Periodontal Treatment Needs and BMI of Type 2 Diabetic Patients

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

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ABSTRACT

Aim: The aim of the study was to assess the periodontal status and periodontal treatment needs of obese type II diabetic patients attending two teaching hospitals in southern Nigeria.
Methods: Selected for this cross-sectional study were 220 participants with Type II diabetes mellitus from two hospitals. A structured questionnaire was used to get necessary data from participants. The periodontal status CPI and periodontal TN were determined using the Community Periodontal Index of Treatment Needs (CPITN). Body mass index (BMI) was recorded.
Results: Periodontitis was high among the participants from the two teaching hospitals. About 50% and 22.7% of the study participants had CPITN codes 2 and 3 respectively. Hence, TN 2 was the treatment need required by a majority (72.7%) of the diabetes mellitus patients.
Conclusion: The prevalence of periodontitis was high among the study groups; however, periodontitis was not significantly associated with obesity. The treatment need of the participants was majorly TN 2.

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1. INTRODUCTION

Periodontal disease is an inflammation and infectious disease of the gingiva, periodontal ligament, and alveolar bone, the supporting structures of the teeth. The periodontal disease presents as gingival or periodontal inflammation. Gingivitis is inflammation that affects only the gingiva and does not affect the supporting tissues of the tooth, while periodontitis affects the deeper tissues that support the teeth [1,2]. The symptoms of periodontitis include inflammation of the gingiva, and attachment loss, with gradual damage to periodontal ligaments and alveolar bone [2]. If left untreated, severe periodontal disease leads to the teeth becoming mobile and resulting in the eventual loss of the teeth [3].

Several studies [4-6] have found a relationship between periodontitis and a variety of systemic diseases. Periodontitis has been linked to an increased risk of morbidity and death in conditions such as diabetes, rheumatoid arthritis, chronic obstructive pulmonary disease (COPD), obesity, osteoporosis, anemia, chronic kidney disease, and pregnancy outcomes [4-6].

Diabetes is a metabolic condition marked by hyperglycemia, which causes damage to the insulin secretion system and/or insulin activities [7]. In most developed nations, diabetes is now the fourth leading cause of mortality, and in many developing countries, it has reached epidemic proportions [8].

Periodontitis is the sixth complication of diabetes, and a pathophysiological link has been shown between the two. On one hand, diabetes mellitus has been proved to be a risk factor for the development of gingivitis and periodontitis. Periodontitis and gingivitis, on the other hand, lead to a loss of blood sugar regulation. In individuals with uncontrolled diabetes, hyperglycemia increases the quantity of glucose in the gingival crevicular fluid (GCF), changes the quality of bacteria, and promotes periodontal disease [9,10].

Diabetes mellitus and periodontal disease have been linked in several clinical and epidemiological investigations [11,12].

Obesity is a complex disease and has become a global epidemic in recent years, with rising prevalence in adults and children [13]. It is described as having an abnormally high level of body fat [14]. This excessive fat buildup is a primary source of morbidity in cardiovascular disease and diabetes, and it has become a socioeconomic burden in all nations [14].

Obesity, though affecting glycemic control indirectly, appears to be a direct and indirect risk factor for periodontal disease. It causes a series of inflammatory reactions that can lead to periodontal disease, by inducing the release of a large number of hormones and pro-inflammatory cytokines called adipokines or adipocytokines (interleukin-6 and tumor necrosis factor-) generated from immune cells in adipose tissue [15-18].

Obesity is one of the key risk factors for diabetes mellitus [19]. There are sufficient evidence of the link between Obesity and diabetes [20-22]. The muscle cells and islet alpha cells in diabetics are insulin resistant, and this leads to higher hepatic glucose synthesis and insulin levels, both of which contribute to obesity [19].

There is increasing concern about the triangle link between diabetes, obesity, and periodontitis [23]. The immunological responses of pro-inflammatory cytokines such as tumor necrosis factor (TNF) and interleukins-6 (IL-6) influence the periodontium in both Type II diabetes and obesity [24]. Furthermore, it has been suggested that periodontitis causes an inflammatory change in adipose tissue, and is linked to obesity, diabetes, and periodontal disease [23].

According to studies, diabetes patients [25], as well as diabetic obese individuals [24], require thorough periodontal therapy.

It was reported that a vast majority of diabetic cases, i.e., about 70% needed TN 3 (complex treatment), and 20.1% needed TN 2(oral hygiene instructions and professional cleaning), [25] While 73.3% required TN 2, (oral hygiene instructions and professional cleaning) and 13.3% required TN 3 (complex treatment) [3]. The periodontal treatment needs were from minimal to moderate, hence related to the prevalence of periodontal diseases [26]. Raising blood glucose levels enhanced the need for complicated periodontal therapy [25].

Previous research has shown that a higher prevalence of periodontal disease and increased periodontal TN were linked to inadequate metabolic control [27]. When compared to adequate dental hygiene, poor oral hygiene raises the risk of periodontitis by two to five times [28].

Hence the aim of this study was to assess the association between periodontal status and treatment needs of obese type II diabetes patients.

2. MATERIALS AND METHODS

Patients at the diabetes outpatient clinics of the departments of Medicine of two Diabetic clinics of the Lagos State University Teaching Hospital (LASUTH) and University of Port Harcourt Teaching Hospital (UNIPORT) in Nigeria were selected as the study population.

The demographic data of participants such as their sex, address, and diabetic profile as well as their heights and weights were collected using a self-administered structured questionnaire. All of the participants gave their informed permission.

Inclusion Criteria: Included were patients with Diabetes Mellitus Type 2 between 30 and 80 years and those who consented to participate in the study.

Exclusion Criteria: Excluded were patients with Type I diabetes, gestational diabetes, those below 30years, and those who did not consent to participate in the study.

2.1 Sample Size Determination

The sample size was determined using the following formula:

Sample size = Z_1-$\alpha/_2$ ^{2} p (1-p)/d ^{2} [29].

Z_1-$\alpha/_2$ = critical value at 95% confidence level is 1.96

Where

d = margin of error, set at 0.05
p = the sample proportion, 15.4.0% (0.154) based on a previous report of good oral hygiene status [24].
q = 1 − p

Sample size = (1.96)2 (0.154) (0.846)/(0.05)2 = 200+20 of none responsive =220

Finally, 220 participants, in equal proportions, were selected from these two centers i.e., 110 from Lagos and 110 from Port Harcourt.

The BMI (Body Mass Index) was used to determine obesity (BMI). According to World Health Organization (WHO) recommendations, BMI was determined as the ratio of weight in kilograms to the square of height in meters [30].

The participants were divided into three BMI classes with BMI >30 (obese) and BMI of 25-29.99 (overweight), and BMI 18.5 to 24.99 (normal).

The Community Periodontal Index of Treatment Needs (CPITN) index was used to assess the periodontal status and periodontal TN. The participants were examined under adequate illumination using the Community Periodontal Index Treatment Need (CPITN) C probes and sterile mouth mirrors. The CPITN-C probe features a 0.5 mm diameter working tip (ball) with markings at 3.5, 5.5, 8.5, and 11.5 mm intervals.

The CPITN was used to evaluate the participants' periodontal status. The following were the scoring criteria:

Code 0 =No sign of disease (healthy periodontium),
Code 1 = Gingival bleeding after gentle probing,
Code 2 = supra or sub-gingival calculus,
Code 3 = pathologic pockets with a depth of 4–5 mm,
Code 4 = pathologic pockets with a depth of more than 6 mm, and

The CPITN Treatment Needs (TN) categories were as follows:

TN 0 = No need for treatment
TN 1 = Need for oral hygiene instructions
TN 2 = Need for oral hygiene instructions and professional cleaning
TN 3 = Need for complex treatment [31].

Oral hygiene status was assessed by the Simplified Oral Hygiene Index (OHI-S), which has two components: the Debris Index-Simplified (DI-S) and the Calculus Index-Simplified (CI-S), which are calculated separately and are summed up to get OHI-S for an individual [12]. The interpretation of the index is as follows: good—0 to 1.2, fair—1.3 to 3.0, and poor—3.1 to 6.0 [32].

2.2 Statistical Analysis

SPSS (Statistical Package for Social Sciences) Statistics for Windows, Version 20 Chicago-based SPSS Inc., was used to enter data and do statistical analysis. Descriptive statistics were used for frequency distribution & cross-tabulation. The Chi-square test was used to look

at relationships between and within variables. The distributional disparities in age, gender, educational level, and obesity (based on BMI) were investigated using the Chi-square test. The variations in periodontal parameters (CPI, and TN) between obesity (based on BMI), of the participants across the two hospitals were investigated using the chi-square test and the Fisher test. The significance level was set at 0.05.

3. RESULTS

A total of 220 participants were selected for this study, with 110 from UPTH and LASUTH respectively. One-fifth and one-tenth of the participants from UPTH and LASUTH respectively were less than 45 years of age. There were 69(62.7%) and 78(70.9%) females

from UPTH and LASUTH respectively. Over three-quarters of the participants in UPTH had secondary and tertiary education, while more than half of the participants from LASUTH had secondary and tertiary education. BMI was normal in 45 (40.9%) of participants from LASUTH and from UPTH 56 (50.9%) were overweight. About three-quarters and three-fifth of participants from UPTH and LASUTH respectively were either overweight or obese [Table 1].

The periodontal disease prevalence from UPTH was 100%, while it was 89.1% from LASUTH.

About 11% of the participants from LASUTH do not require any periodontal treatment. Most of the participants from both centers had

Table 1. Characteristics of the study population

Characteristics	UPTH N (%)	LASUTH N (%)	P- value
Age			0.07*
<45	23 (20.9)	14 (12.7)	
>45	87 (89.1)	96 (87.3)	
Gender			0.12*
Female	69 (62.7)	78 (70.9)	
Male	41 (37.3)	32 (29.1)	
Educational Level			0.23*
None	6 (5.4)	6 (5.4)	
Primary	20 (18.2)	32 (29.1)	
Secondary	29 (26.4)	29 (26.4)	
Tertiary	55 (50.0)	43 (39.1)	
BMI			0.004*+
Normal	28 (25.5)	45 (40.9)	
Overweight	56 (50.9)	32 (29.1)	
Obese	26 (23.6)	33 (30.0)	
OHIS score			0.403*
Good	67(60.9)	58(52.8)	
Fair	24(21.8)	26(23.6)	
Poor	19(17.3)	26(23.6)	
Total	**110 (100.0)**	**110 (100.0)**	

Chi-square test* Highly Significant +

Table 2. CPI and TN scores of participants in UPTH and LASUTH

Variables	Hospitals						
CPITN Codes	UPTH N (%)	LASUTH N (%)	Total N (%)	TN	UPTH N (%)	LASUTH N (%)	Total N (%)
0	0 (0.0)	12 (10.9)	12 (5.4)	0	0 (0.0)	12 (10.9)	12(5.4)
1	18 (16.4)	16 (14.5)	34(15.5)	1	18 (16.4)	16 (14.5)	34(15.5)
2	57 (51.8)	53 (48.2)	110(50.0)	2	85 (77.2)	75 (68.2)	160(72.7)
3	28 (25.4)	22 (20.0)	50(22.7)				
4	7 (6.4)	7 (6.4)	14(6.4)	3	7(6.4)	7(6.4)	14(6.4)
Total	**110**	**110**	**220**		**110**	**110**	**220**
p-value	0.01* +				0.005* +		

Chi-square test* Highly Significant +

CPITN codes 2 and 3(TN 2). The P-value for CPITN and TN between UPTH and LASUTH was 0.01, and 0.005 respectively [Table 2].

None of the study participants in the 3 BMI groups from UPTH had healthy periodontium, while from LASUTH, 5(15.6%) in the overweight group had healthy periodontium. Most of the participants in all three BMI groups from UPTH and LASUTH respectively had CPITN score 2. About 3(11%) of participants from UPTH and 4(9%) from LASUTH with normal weight had CPITN code 4. The association between CPITN

code 2 and BMI of UPTH and LASUTH was statistically significant with p= 0.009 [Table 3a].

BMI was not statistically significant with periodontal treatment needs from both hospitals. The Periodontal treatment needs among participants from both centers were mostly TN 1 and TN 2. No participant in the overweight group from LASUTH had TN 3. The P-value for BMI and TN of UPTH and LASUTH participants was 0.843, and 0.589 respectively. Only the association between TN 2 and BMI of UPTH and LASUTH was statistically significant with p= 0.009 [Table 3b].

Table 3a. The prevalence of periodontitis of participants based on BMI

Hospitals	UPTH			LASUTH				
				BMI				
CPITN code	Normal N (%)	Overweight N (%)	Obese N (%)	CPITN score	Normal N (%)	Overweight N (%)	Obese N (%)	p-value
0	0 (0.0)	0 (0.0)	0 (0.0)	0	4 (8.9)	5 (15.6.)	3 (9.1)	1.00**
1	4 (14.3)	10 (17.9)	4 (15.4)	I	5 (11.1)	6(18.8)	5 (15.2)	0.618**
2	13(46.4)	27 (48.2)	17(65.4)	2	26(57.8)	13 (40.6)	14(42.4)	0.009*
3	8 (28.6)	16 (28.6)	4 (15.4)	3	6 (13.3)	8 (25.0)	8 (24.2)	0.163*
4	3 (10.7)	3 (5.4)	1(3.8)	4	4 (8.9)	0 (0.0)	3 (6.4)	0.241**
Total	28(100)	56 (100)	26 (100)	Total	45 (100)	32 (100)	33(100)	
p=0.687*				p=0.461*				

Chi-square test Fisher test**, significance at p < 0.05*

Table 3b. Periodontal treatment need of participants based on BMI

Hospitals	UPTH				LASUTH			p-value
				BMI				
TN	Normal N (%)	Overweight N (%)	Obese N (%)	TN	Normal N (%)	Overweight N (%)	Obese N (%)	
0	0(0.0)	0 (0.0)	0 (0.0)	0	4 (8.9)	5 (15.6.)	3 (9.1)	1.00**
1	4 (14.3)	10(17.9)	4 (15.4)	1	5 (11.1)	6(18.8)	5 (15.2)	0.618**
2	21(75.0)	43(76.8)	21(80.8)	2	32(71.1)	21(65.6)	22(66.6)	0.009*
3	3(10.7)	3(5.4)	1(3.8)	3	4 (8.9)	0 (0.0)	3(6.4)	0..241**
Total	28 (100)	56 (100)	26 (100)	Total	45 (100)	32 (100)	33 (100)	
p=0.843*				p=0.589*				

Chi-square test Fisher test**, significance at p < 0.05*

Table 4. Logistic regression for CPITN scores

Variable	Odds(95%CI)	P value
Age group	0.051(-0.199 -0.300)	0.691
Sex	0.250(-0.350 -0.850)	0.414
DM Duration	0.056(-0.665-0.312)	0.665
Exercise	-0.787(-1.365- -0.210)	0.008+
OHIS	0.630(0.214-1.046)	0.003+

Highly Significant +

Only Simplified Oral Hygiene Index scores and exercise were significant p≤0.05.

The odds ratio for change in CPITN code in oral hygiene was 0.63 CI (0.21,1.0) and exercise reduction in CPITN code was – 0.79 CI(-1.30,-0.21).

4. DISCUSSION

All the participants from the two teaching hospitals had periodontitis however; periodontitis was not shown to be substantially linked to obesity, in this study. Similarly, Pham et al. [33] found no link between periodontitis and obesity in Vietnamese patients in their research on the interaction between obesity, Type 2 diabetes mellitus, and periodontitis. Obesity and periodontal disease have been linked in several types of research [34,35].

Some of our participants had healthy periodontium. This is not unexpected, as diabetes does not induce gingival or periodontal disease on its own, but it can cause an exaggerated response of the gingiva to bacterial plaque accumulation [36].
Furthermore, periodontal pathogens in diabetes patients' oral microbial flora, which accumulate owing to a greater glucose concentration in saliva and crevicular fluid, contribute to the severity of the periodontal disease [24].

The most frequent CPITN among study participants from both hospitals was CPITN score 2.
The prevalence of calculus was higher (65.4%) in the obese group from UPTH and 57.8% in the non-obese group from LASUTH. Periodontitis and tooth loss were more common in poorly managed diabetics with significant calculus on their teeth than in well-controlled diabetics or non-diabetics [3].

In our study, the reported CPITN score 3 and 4 in all BMI groups was similar to the report of SriChinthu et al. [24] among their participants.

Our findings indicated that obese diabetics had more severe cases of periodontitis than non-obese diabetics. Pham et al. [33] found that diabetics with poor metabolic control have higher periodontitis in the Vietnamese population [25] and Hajimaghsoodi et al. [37] in the Iranian population. Previous studies have reported that Diabetic patients who were well managed had better periodontal health than those who were poorly controlled, and the prevalence of periodontal pockets decreased as diabetes control increased [25,38].

The relationship between BMI and periodontal treatment needs was not statistically significant from both hospitals. The report of Chatzopoupus et al. [26] in their study on the association between BMI, diabetes, and periodontal treatment needs in Greece was in line with ours.

The Treatment Needs of the participants was mostly TN 2. This is in line with the findings of research on periodontal disease and treatment needs among T2DM patients in Bandung City done on periodontal disease and treatment needs among patients with T2DM in Bandung City [3]. This was in contrast to the report of Chatzopoupus et al. [26] where the periodontal treatment needs was mostly TN3.

The study is limited in that the samples collected for this study were hospital-based; hence, not representative of the general population. To determine the direction and intensity of the triangle interactions between obesity, Type 2 diabetes, and periodontitis, a study of the general population is required.

5. CONCLUSION

Though the prevalence of periodontitis was high among the study groups, however, obesity was not shown to be a major factor in periodontitis. The treatment needs of the participants was majorly TN 2.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The Health Research and Ethics Committees of LASUTH and UPTH granted ethical permission before the start of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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