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Hypertension and Diabetes Mellitus Co-morbidity and Periodontal Status of Patients Attending a Tertiary Dental Centre in Lagos, Nigeria

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Conflict of interest: Nil

Abstract

The global burden of hypertension, diabetes mellitus DM and periodontal diseases is significant. The relationship of diabetes mellitus and periodontal health is well known; several studies have also reported a profound relationship between cardiovascular status and oral health. However, studies examining the impact of coexisting hypertension and diabetes mellitus on periodontal status are scanty.

Objective: To determine the effect of hypertension and diabetes comorbidity on the periodontal health status of patients attending the dental centre of a tertiary institution in Lagos, Nigeria

Methodology: This is a cross-sectional study conducted at the outpatient clinic of the Dental Centre, Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, Nigeria. 246 consenting individuals were included in the study. Sociodemographic data was recorded on a self-administered questionnaire. Trained personnel and/or nurses took the blood pressure measurements. Fasting blood glucose values were determined using a FineTest® glucometer. The Community Periodontal Index (CPI) and the gingival index were used to assess the periodontal status. Data was analysed with SPSS version 25.0. Descriptive statistics were carried out for the demographic variables. Chi-square and Fisher's exact tests were used to test for relationships between categorical variables. Logistic regression was used to determine the association of hypertension, diabetes mellitus and their comorbidity and periodontal disease

among the subjects while controlling for the confounders. Significance was set at $p \leq 0.05$.

Results: The mean age of the subjects was 39.9 ± 12.5. The mean systolic and diastolic blood pressure were 125.4 and 78.9, respectively, while the mean random blood glucose was 99.7(±34.3)mg/dl. In this study, the prevalence of Periodontal disease was 169(68.3%). The prevalence of hypertension and DM in this study was 67(27.2%) and 25(10.2%), respectively. Prevalence of hypertension and DM comorbidity was 8(3.3%). Severe periodontitis was 2(15.4%) in systolic hypertension alone and 2(6.1%) in systolic with diastolic hypertension; no subject had severe periodontitis in the diastolic alone group ($p = 0.04$). Eight (32%) of the diabetic subjects had moderate gingivitis, and 9 (36%) had no periodontal disease ($p = 0.002$). The majority of the subjects with comorbidity 3(37.5%) had severe periodontitis ($p = 0.001$). Logistic regression analysis revealed that only the highest attained education status and oral hygiene status had a significant relationship with the CPI in this study.

Conclusion: There is a significant effect of hypertension, diabetes mellitus, and their comorbidity on periodontal disease among the subjects studied. However, only educational status and oral hygiene were significant when the covariates were controlled for. Regular blood pressure and blood sugar checks, along with effective oral hygiene measures, are essential for the general population.

Keywords: Comorbidity, Hypertension, Diabetes, Periodontal disease

Introduction

Periodontal disease (PD) is a chronic inflammatory disease characterised by the destruction of the supporting structures of the teeth. PD was said to affect over 1 billion people in 2021 worldwide. Gingivitis is a mild form of periodontal disease that is completely reversible [1-4]. Periodontitis, on the other hand, is a more severe and chronic form that can eventually result in tooth loss, and is increasingly recognised as being associated with systemic conditions. The aetiology of periodontal destruction is linked to a complex interrelation between periodontal infection by plaque microbe and host defence. The host defence may be altered by environmental, psychosocial and physical conditions, thereby predisposing the periodontal tissues to a more severe disease and hastening its progression. Many researchers have noted the increased prevalence and severity of attachment loss with advancing age. Presence of one or more systemic conditions was observed in 46 - 47% of patients with periodontal disease [5-8].

Hypertension and diabetes mellitus (DM) are two of the most prevalent chronic conditions worldwide; and frequently coexist in many individuals due to their shared risk factors (obesity, sedentary lifestyle, and poor dietary choices),[9] and they are becoming leading causes of morbidity and mortality in Africa as a whole, and sub-Saharan Africa (SSA) in particular[10]. Both diseases have significant systemic implications and are known to affect oral health, particularly periodontal status. They may not directly cause periodontal disease, but they can predispose individuals to it and hasten and worsen its progression [8].

Diabetes mellitus is a chronic metabolic disease that affects more than 100 million people with periodontal disease (gingivitis and periodontitis) globally and is most frequently associated with tooth loss [8,11,12]. The risk for periodontal disease is higher in individuals with poorly controlled DM than in those with well-controlled. A bidirectional relationship has also been reported between DM and periodontal disease [13,14]. The uptake of glucose

by skeletal muscle mediated by insulin can be reduced by periodontal disease, thus negatively influencing patients' glycaemic control. The increase in pro-inflammatory mediators due to periodontal infection leads to insulin resistance and a reduction in insulin action. Therefore, patients with untreated periodontal disease have more difficulty controlling their blood sugar and, conversely, are at a higher risk of developing periodontal disease [8,15].

Hypertension is defined as Systolic blood pressure (BP) ≥140 mmHg and or diastolic pressure ≥ 90mmHg. In the Nigerian general population, the prevalence of hypertension has been reported to range from 12.4 to 34.8% and an incidence of 32% among dental patients [16,17]. with a large number not aware of their status because many do not routinely check their BP [17]. An increased prevalence of hypertension reported with poor periodontal health was attributed to shared common risk factors for both diseases. However, Del Pinto et al reported an association between periodontitis and hypertension that is independent of common risk factors [18]. Carra et al [19] in a cohort study reported a significantly higher incidence of arterial hypertension with the presence of periodontitis and unreplaced missing teeth (hazard ratio: 1.13; 95%CI: 1.03-1.23) while a regular annual visit to the dentist was associated with a lower risk (hazard ratio: 0.88; 95% CI: 0.80-0.97). Therefore, it is essential to consider periodontal health when evaluating an individual's risk of developing arterial hypertension.

Most previous studies focused on the relationship between DM, hypertension and periodontal health separately; hence, the literature is scarce on periodontal health in individuals with co-existing DM and hypertension. This study explores the relationship between hypertension, DM, hypertension co-existing with DM and periodontal health in dental patients.

Materials & Methods

LASUTH is a government-owned tertiary hospital in Ikeja, the capital city of Lagos State, South-Western Nigeria. It provides services for residents of Lagos State and its environs from varying economic and educational levels. It receives approximately 1,500 new patients of all age groups and socioeconomic strata per month due to its central location and being the recipient tertiary hospital for the state's 26 general hospitals.

Approval for the study was obtained from the Health Research and Ethics Committee of the hospital (LASUTH). Adult patients visiting the Dental Centre who consented and were 18 years and above were drafted to participate in the study using convenient sampling method. All participants gave informed consent before participation in the study was allowed.

The minimum sample size "n" was determined based on using the formula:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

P (Prevalence of hypertension among dental patients) = 17.7% [20];

d (Error margin = 5%, Z (statistic for a 95% level of confidence) = 1.96

$$n = \frac{1.96^2 \times 0.177(1-0.823)}{0.05^2} = \frac{3.84 \times 0.177 \times 0.823}{0.0025} = 223.6 \text{ appox. } 224$$

Putting the Non-response rate at 10%, the sample size required for this study is two hundred and forty-six (246). 246 consecutive consenting individuals who met the inclusion criteria were included in the study.

Inclusion Criteria

Adults, 18 years old or more, and having a minimum of 10 teeth present in each jaw were included in the study.

Exclusion Criteria

Previously diagnosed hypertensive and diabetic patients already receiving treatment were exempted from

participating in the study. Participants who are currently taking anti-inflammatory drugs, antibiotics, steroid therapy, or have been diagnosed with any immune-compromising disease, as well as pregnant women and smokers, were excluded. Patients currently on periodontal treatment or who had scaling and polishing or any other periodontal therapy done within 6 months before the commencement of the study were also excluded.

Measures

- Sociodemographic data was recorded on a self-administered questionnaire.
- Trained personnel and/or nurses took the blood pressure measurements. After resting in a sitting position for 10 minutes, three consecutive blood pressure readings were taken at 5-minute intervals with a digital sphygmomanometer (Omron) and an average of these measurements was calculated for each participant. All participants abstained from caffeine intake and physical exercise for one hour before the measurement. Participants with systolic blood pressure readings higher than or equal to 140 mmHg and/or diastolic blood pressure higher than or equal to 90mmHg were regarded to have hypertension and categorised into Stage I hypertension 140–159/90–99 mmHg and Stage II hypertension >160/100 mmHg. Blood pressure of 120–139/80–89 mmHg was regarded as pre-hypertension [23-25].
- Fasting blood glucose values were determined using a FineTest® glucometer (Auto recoding TM Premium, Infopia Co. Ltd., Republic of Korea). Participants who fulfilled the inclusion criteria and had observed an overnight fast were made to wash their hands with soap under running water and then dried with a clean disposable napkin. Thereafter, the thumb was pricked with a sterile lancet to get a drop of blood, which was placed on a test strip inserted into the glucometer after a 70% alcohol swab was used to clean it. Individuals with a fasting blood sugar ≤ 99 mg/dl, 100 -125 mg/dl and ≥126 mg/dl were regarded as normal, pre-diabetic, and diabetic, respectively [20]. Individuals diagnosed with hypertension or blood sugar levels exceeding 110 mg/dL were referred to the physician for a comprehensive clinical evaluation and appropriate treatment.
- Community Periodontal Index (CPI) was employed to assess periodontal status. CPI, a simple and highly reproducible index is universally accepted as a standard index for assessing periodontal disease. A specially designed CPI-WHO probe with a 0.5mm ball end was used for recording based on bleeding, calculus, and pocket depth on a scale of 0-4: CPI = 0, healthy; CPI = 1, bleeding on probing; CPI = 2, calculus; CPI = 3, periodontal pocket 4–5 mm; CPI = 4, periodontal pocket 6 mm. or more. CPI = X, excluded sextant (< 2 teeth present).

  All the teeth in each sextant are examined, and the highest score is recorded as the score for the sextant. The highest score of the 6 records is regarded as the CPI score for participants. Based on participants' CPI score, they were grouped into: Healthy (CPI score 0), Gingivitis (CPI score 1 & 2), Mild-Moderate Periodontitis (CPI score 3) and Severe Periodontitis (CPI score 4).
- Simplified Oral Hygiene Index (OHI-S) of Green and Vermillion measured the participants' oral cleanliness; the oral hygiene status. OHI-S has two components: debris and calculus, each of which is scored on a scale of 0 to 3. The debris and calculus

scores were summed up to obtain the OHI-S score. Based on the OHI-S score, oral hygiene status was judged as good (score 0.1–1.2), fair (score 1.3–3.0), and poor (score 3.1–6.0).

- Bleeding on probing (BOP) index assessed the extent of gingival inflammation on a scale of 0 and 1; 0 = Absent, 1 = Present. Percentage bleeding points was calculated for each participant and gingivitis status was classified into three groups: no gingivitis or healthy gingiva (BOP% < 10%), localised gingivitis (BOP 10% - 30%), or generalised gingivitis (BOP > 30%) [21].
- Gingival Index assessed the severity of gingival inflammation on a scale of 0 to 3

  0 = Absence of inflammation

  1 = Mild inflammation - slight change in colour and texture

  2 = Moderate inflammation - moderate glazing, redness, oedema and bleeding on probing

  3 = Severe inflammation - marked redness and hypertrophy, tendency to spontaneous bleeding or ulceration. Based on the GI-score, the severity of gingival inflammation was graded as: mild gingivitis (0.1 – 1.0), moderate gingivitis (1.1 – 2.0) and severe gingivitis (2.1 – 3.0) [22].

Data Analysis

These data were recorded and analysed with SPSS version 25.0 (IBM Corp., Armonk, NY, USA) for statistical analysis. Descriptive statistics was carried out for the different variables. Categorical variables such as age groups, sex, educational status, CPI, hypertension categories, blood sugar levels etc were expressed as frequencies and percentages, while numerical variables such as age and oral hygiene scores were expressed as means. Pearson's chi-square and Fisher's exact tests were used to test for relationships between the other categorical variables and periodontal disease in the subjects. Logistic regression was used to determine the relationship between DM, hypertension and their comorbidity and the periodontal status of the subjects in the study while controlling for the confounders, the odds ratio (OR) and the 95% confidence interval will also be assessed. Statistical significance was inferred at $p \leq 0.05$.

Results

A total of 246 subjects participated in this study. The mean age was 39.9±12.5years, and the age ranged from 18years to 76years. The mean systolic and diastolic blood pressure were 125.4 mmHg and 78.9mmHg, respectively, while the mean random blood glucose was 99.7 (±34.3) mg/dl. The mean OHI score, bleeding index score, and gingival index score were 1.87 (±0.92), 28.1 (±33.5), and 1.18 (±0.6), respectively. The mean CPI score was 1.24 (±1.1).

In this study, the prevalence of Periodontal disease was 169 (68.3%), and 78 (31.7%) subjects presented with a healthy periodontium. Prevalence of gingivitis, mild to moderate periodontitis and severe periodontitis were 137(55.7%), 25 (10.2%) and 6 (2.4%), respectively (Figure 1).

Figure 1: Prevalence of Periodontal Disease Among The Subjects

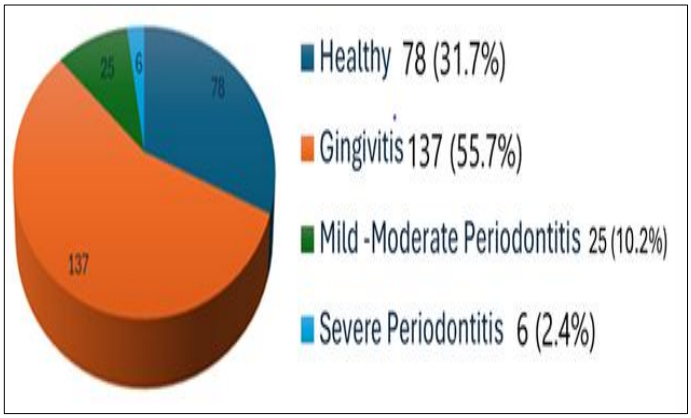
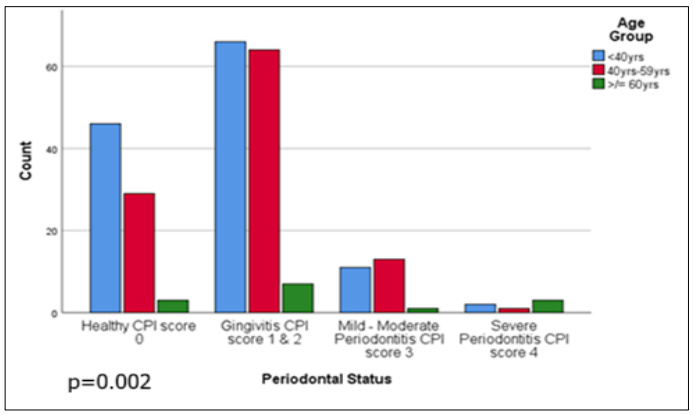


Figure 2 shows that subjects below 40 years old formed the majority in this study, 125 (50.8%), those aged between 40 and 59years were 107 (43.5%), while those above 60 years old were 14 (5.7%). Those aged below 40 years have the highest prevalence of periodontal disease, 79 (63.2%), and it decreased with the severity of the disease. Gingivitis accounted for 66 (83.5%), mild to moderate periodontitis 11(13.9%) and severe periodontitis 2 (2.5%). Among the 40 to 59 years old majority of those with periodontal disease had gingivitis (64, 82.1%), while severe periodontitis was the least, 1 (1.3%). Among the above 60-year-olds, gingivitis constituted the highest of the periodontal disease, 4 (63.6%), severe periodontitis was 3 (27.3%) and mild - moderate periodontitis was the least 1 (9.1%). The difference was significant, p=0.002.

Figure 2: Description of the age groups by the CPI scores



Amongst the male subjects 106 (43.1%), majority 60 (56.6%) had gingivitis, this is followed by those with mild-moderate periodontitis 13 (12.3%), the least were those with severe periodontitis 3 (2.8%), the female subjects 140 (56.9%), majority (77 (55.0%) had gingivitis while those with severe periodontitis were the least 3 (2.1%). The difference, however, was not significant (p > 0.05) (Table 1). Most of the subjects attained post-secondary education 206 (83.7%), while those who attained secondary and primary education were 28 (11.4%) and 12 (4.9%), respectively. Of the post-secondary education group, 115 (55.8%) had gingivitis, while those with severe periodontitis accounted for 2 (16.7%) in the primary education group, 2 (7.1%) in the secondary education group, and 2 (1.0%) in the post-secondary group. This difference was significant, p = 0.03 (Table 1).

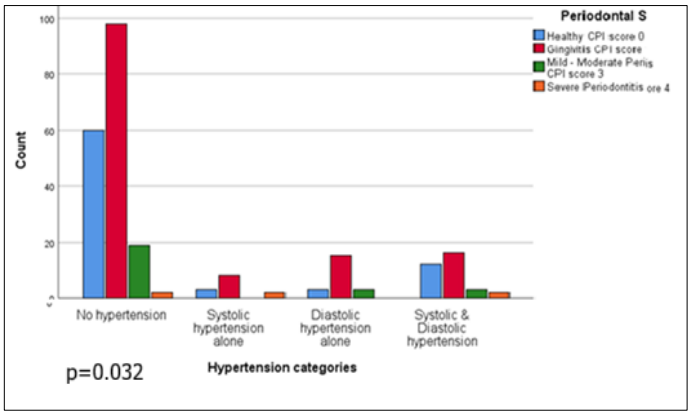
Assessment of the oral hygiene habits revealed that 153 (62.2%) of the subjects brush their teeth once daily, of which 96 (62.7%) had gingivitis and 16 (10.5%) had mild-moderate periodontitis, and 2 (1.3%) had severe periodontitis. Only 86 (35.0%) brushed twice daily, of which 38 (44.2%) had gingivitis, and 4 (4.7%) had severe periodontitis. Seven (2.9%) of the subjects brush more than twice daily. The difference was not significant, p > 0.05 (Table 1). Most, 138 (56.1%) of the subjects presented with good oral hygiene (OHI O.1-1.2), of which mild gingivitis was most prevalent, 51 (37%), and the least was severe periodontitis, 3 (2.2%). Ninety-six (39%) had fair oral hygiene (OHI 1.3-3.0) of which majority had moderate gingivitis 51(0.5%), of those with poor oral hygiene (OHI 3.1-6.0) 12 (4.9%) most of the subjects had mild to moderate 5 (41.7%) while mild gingivitis and moderate gingivitis accounted for 1 (8.3%) each. The difference was significant, p = 0.001 (Table 1).

Table 1: Pearson Chi-Square Analysis of Changes in Periodontal Disease Attributable to the Independent Variables

Variables		Healthy N(%)	Gingivitis N(%)	Mild to moderate periodontitis N(%)	Severe periodontitis N(%)	Total N(%)	p-value
Sex	Female	48(34.3)	77 (55.0)	12 (8.6)	3 (2.1)	140 (56.9)	0.651
	Male	30(28.3)	60 (56.6)	13 (12.3)	3 (2.8)	106 (43.1)	
Highest educational level	Primary	3 (25.0)	7 (58.3)	0	2 (16.7)	12 (4.9)	0.021*
	Secondary	9 (32.1)	15 (53.6)	2 (7.1)	2 (7.1)	28 (11.4)	
	Tertiary	66 (32)	115 (55.8)	23 (11.2)	2 (1.0)	206 (83.7)	
Frequency of tooth brushing (daily)	Once daily	39(25.5)	96 (62.7)	16(10.5)	2(1.3)	153(62.2)	0.074
	Twice	36(41.9)	38 (44.2)	8 (9.3)	4 (4.7)	86 (35.0)	
	More than twice	3 (42.9)	3 (42.9)	1 (14.3)	0	7 (2.8)	
Oral hygiene status	Good	66(47.8)	61(44.2)	8(5.8)	3 (2.2)	138(56.1)	0.000*
	Fair	11(11.5)	72 (75.0)	12(12.5)	1 (1.0)	96 (39.0)	
	Poor	1(8.3)	4 (33.3)	5(41.7)	2 (16.7)	12 (4.9)	
Diabetes	None	72 (32.6)	126 (57.0)	20 (9)	3 (1.4)	221 (89.8)	0.003*
	Yes	6 (24)	11 (44.0)	5 (20)	3 (12)	25 (10.2)	
Comorbidity (Hypertension + Diabetes)	No	76 (31.9)	136 (57.1)	23 (9.7)	3 (1.3)	238 (96.7)	0.000*
	Yes	2 (25)	1(12.5)	2 (25.0)	3(37.5)	8 (3.3)	

The prevalence of hypertension in this study was 67 (27.2%). Subjects with systolic hypertension alone (≥140 mmHg) were 13 (5.3%), those with diastolic hypertension alone (≥ 90 mmHg) was 21(8.5%) while those with both concurrently were 33 (13.4%). Gingivitis was more prevalent among subjects with systolic hypertension alone 8 (61.5%), diastolic hypertension alone 15 (71.4%) and also in those with concurrent systolic and diastolic hypertension, 16 (48.5%). Severe periodontitis was 2 (15.4%) in systolic hypertension alone and 2 (6.1%) in systolic with diastolic hypertension; no subject had severe periodontitis in the diastolic hypertension alone group. The difference was significant (p=0.032) (Figure 3).

Figure 3: Description of the Hypertension Categories and CPI Scores



Twenty-five (10.2%) of the subjects had a random blood sugar level ≥ 126 mg/dL (diabetic), of which 11 (44.0%) had gingivitis, followed by mild to moderate periodontitis

in 5 (20%), severe periodontitis was in 3 (12%). The difference was significant (p = 0.003) (Table 1). A total of 8 (3.3%) subjects had coexisting hypertension and diabetes, of which 3 (37.5%) had severe periodontitis, 2 (25%) had mild to moderate periodontitis, and 1 (12.5%) had gingivitis. The difference was highly statistically significant (p = 0.001) (Table 1).

Ordinal logistic regression showed that only the highest education status attained OR 0.57 CI (0.05, 1.09) and oral hygiene status OR 1.8 CI (1.39, 2.34) had a significant relationship with the CPI in this study, with p-values of 0.03 and 0.001, respectively (Table 2).

Table 2: Logistic Regression Assessing the Relationship of the Independent Variables and CP

Parameter Estimates								
		Odds ratio	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Age Group	.197	.236	.700	1	.403	-.265	.659
	SexQ2	.030	.250	.015	1	.903	-.459	.520
	Education Level	.572	.266	4.616	1	.032	.050	1.094
	HPTN categories	-.313	.305	1.050	1	.305	-.910	.285
	HPTN status	.966	.766	1.590	1	.207	-.535	2.466
	Diabetic Status	.852	.690	1.524	1	.217	-.500	2.203
	Diabetic Category	-.240	.291	.681	1	.409	-.812	.331
	HPTN with DM	1.398	.865	2.610	1	.106	-.298	3.094
	BrushingFrequencyQ7	-.210	.235	.796	1	.372	-.672	.251
	TeethCleaningMaterialQ8	.198	.257	.598	1	.439	-.304	.701
	OH Status	1.864	.243	58.855	1	.000	1.388	2.340

Discussion

The majority of the subjects in this study were middle-aged aged even though the ages ranged between 18 and 76 years. While the females were more in this study, more than 80% of the subjects attained a post-secondary level of education, which reflects the urban location of the study and the positive impact of the level of education attained on oral health. This may also explain why more than 56% have good oral hygiene and about 5% poor, despite the fact that more than 60% of the subjects in this study brush their teeth only once daily (Table 1).

The prevalence of periodontal disease in this study was 68.6% [26], which is similar to a previous study in Ile-Ife, Nigeria. In this study, gingivitis accounted for 56% while periodontitis was 12.6% (Figure 1). Gingivitis was most common among subjects aged less than 40 years, and 40-59 years. Severe periodontitis was more prevalent in elderly subjects above 60 years old compared to other age groups in the study (Figure 2). The difference was significant ($p<0.05$). The direct relationship of the prevalence of severity of periodontal disease with increased age may be a result of poor assess to dental care and inadequate attention paid by the elderly to their oral

health. This trend was also seen in an Indonesian study [27]. Assessment of the significant difference in the severity of periodontal disease from healthy to severe, as it relates to covariates including diabetes and hypertension in the subjects, showed a statistically significant difference (p = 0.001) in the severity of periodontal disease across different age groups. Periodontal disease was more prevalent in the younger age group below 40 years (63.2%), which was inversely proportional to the severity of the disease [27, 28].

More than half of both male and female subjects had mild gingivitis as the most prevalent, while severe periodontitis was 2.8% and 2.1%, respectively. The difference, however, was not significant (p>0.05) (Table 1). This is in disagreement with other studies that reported sex as a significant factor in the prevalence of periodontal disease [29,30]. Subjects with post-secondary education (83.7%) formed the majority in this study, with most (55.8%) having gingivitis. This difference was significant, p=0.021 (Table 1). Low educational level is known to be associated with more severe forms of periodontal disease [31].

Over 60% of the subjects brush their teeth once daily, of which 62.7% had gingivitis and 2 (1.3%) had severe periodontitis. This suggests a need to emphasise brushing of teeth at least twice and not more than thrice daily in this population [32,33]. About one-third of the subjects brush their teeth twice daily; this proportion is lower than in other studies [32-34]. A Lithuanian study reported that more than 80% brush their teeth twice daily [32-34]. The difference was not significant, p > 0.05 (Table 1). Most, 56.1% of the subjects presented with good oral hygiene, of which mild gingivitis was most prevalent (37%). Thirty-nine per cent had fair oral hygiene, of which the majority had moderate gingivitis (51%, 0.5%). Most subjects with poor oral hygiene (4.9%) had mild to moderate periodontitis (5, 41.7%). The difference was highly significant, p=0.001 (Table 1).

The prevalence of hypertension amongst the subjects in this study was 27.2%, which is consistent with a recent study in Nigeria by Adeloye et al that reported a range of 22-44% over 15 years [35]. Systolic hypertension alone (≥ 140mmHg) accounted for 5.3%, while diastolic hypertension alone (≥ 90mmHg) was 8.5%, and those with both concurrently were 13.4%. There was a statistically significant difference in the prevalence of periodontal disease in relation to hypertension among the subjects studied (p = 0.032) (Figure 3). This is explained by the association with changes in collagen metabolism, increased systemic inflammation, and oxidative stress in both conditions [36, 37, 38]. Gingivitis was the most prevalent in 8 (61.5%), 15 (71.4%) and 16 (48.5%) of subjects with systolic hypertension alone, diastolic hypertension alone and those with both systolic and diastolic hypertension, respectively. Severe periodontitis was more than twice as prevalent in systolic hypertension alone (15.4%) than in systolic with diastolic hypertension (6.1%); no subject had severe periodontitis in the diastolic alone group.

The prevalence of diabetes in this study was 10.2%, which is higher than previous reports in Nigeria. Olamoyegun et al reported 7% in a 2024 study [39,40]. This may be because this study is hospital-based; the majority (44.0%) had gingivitis, and 12% had severe periodontitis. The difference was statistically significant (p = 0.003) (Table 1). This emphasises the well-known association between diabetes mellitus and periodontal disease, which is often bidirectional [40].

The prevalence of comorbidity of hypertension and diabetes was 3.3%, similar to Opeodu and Adeyemi, who reported 3% prevalence in a study in Ibadan, Nigeria [9].

Most (37.5%) had severe periodontitis, mild to moderate periodontitis was 25%, and 12.5% of them had moderate gingivitis. The pattern of prevalence increased with severity in those with comorbidity, which means the higher the blood pressure concurrently with increasing blood sugar, the more severe the periodontal disease. The difference was statistically significant (p = 0.000; Table 1). This can be explained by the cumulative effect of systemic inflammatory mediators and oxidative stress associated with both morbidities [36,37,40].

When the covariates were controlled for in a regression analysis, only the highest education status attained and oral hygiene status showed a significant relationship with the CPI in this study, with p-values of 0.032 and 0.000, respectively (Table 2). This indicates that the association of comorbidity of hypertension and diabetes mellitus in the subjects studied was only significant when other covariates were contributory. The result of this study is at variance with previous studies that have reported an independent association between hypertension, diabetes mellitus and periodontitis [40].

Conclusion

There is a significant effect of hypertension, diabetes mellitus, and their comorbidity on periodontal disease among the subjects studied, as well as other variables in the study. However, only educational status and oral hygiene were significant when the covariates were controlled for. The role of comprehensive general and oral health education and promotion cannot be overemphasised. Regular blood pressure and blood sugar checks, as well as efficient oral hygiene measures, are important in the general population.

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