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Lipid Profile and the Severity of Periodontitis among Tertiary Hospital Patients in a Semi-Urban Population in Southwestern Nigeria

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Abstract

The prevalence of hyperlipidemia among Nigerians is established, while the relationship between it and periodontitis has been studied globally. This study aimed to investigate the relationship between lipid profile and severity of periodontitis among Nigerians. 195 patients were drawn from the family medicine clinic of the Obafemi Awolowo University Teaching Hospital Ile-Ife Osun state Nigeria. Sociodemographic data was obtained using a closed-ended questionnaire, simplified oral hygiene index (OHI), periodontal disease index (PDI), clinical attachment loss (CAL), and periodontal pocket depth (PPD) were also estimated. A full mouth mean CAL ≥0.6mm was considered as periodontitis. Lipid profile was carried out at the chemical pathology department of the same institution by spectrophotometry. Appropriate parameters were determined for descriptive variables. A two-way t-test was done for the mean values of the intraoral and the lipid parameters. Data was exposed to logistic regression to eliminate confounders. Male to female ratio was 1:1.6 with a mean age of 37.42±12.95. High-density lipoproteins (HDL) and triglycerides have a statistically significant relationship with CAL and PPD ($p<0.05$). Logistic regression showed statistical significance for total cholesterol ($p<0.05$) in females only. Following the trend with other associated chronic diseases, HDL was higher in the periodontally healthy subjects and those with mild chronic periodontitis, while it was lower in those with moderate and severe chronic periodontitis. This relationship was inverse for low-density lipoproteins (LDL). Increase in LDL/HDL had a linear relationship with the severity of chronic periodontitis from mild to severe. This emphasises the need for oral health education in the community and regular lipid investigations.

Keywords: Periodontitis, Lipoproteins, Clinical attachment loss, Triglycerides, Severity, Pocket.

INTRODUCTION

Hyperlipidemia is defined as an increase in one or more of lipid components; (total cholesterol (TC), triglycerides TG, low density lipoproteins (LDL), very low-density lipoproteins (VLDL), and high-density lipoproteins (HDL) [1-3]. Low-density lipoproteins (LDL) is carried away from the liver and gets deposited in arterial walls, muscles, and other tissues where it becomes pathogenic, while high-density lipoprotein (HDL) carries excess cholesterol back to the liver, where it is metabolized and eliminated from the body. Hyperlipidemia is diagnosed when serum TC is more than 6.1mmol/l or 239mg/dl, serum TG is more than 2.2mmol/l or 199mg/dl, serum LDL is more than 3.3mmol/l or 129mg/dl and serum HDL is less than 1.5mmol/l or 60mg/dl LDL/HDL is more than 3.25 [2, 4]. The prevalence of hyperlipidemia in Nigeria was 38%, with prevalence higher in women (42%) than men (38%). It was higher amongst urban (52%) than rural dwellers (10%). It was estimated that about 21.9 million persons aged over 20 years had hypercholesterolemia in Nigeria in 2015 [1]. Hyperlipidemia has a causal relationship with atherosclerosis, ischemic heart disease, and stroke, while high serum level of TG has been related to pancreatitis [3-7]. Predisposing factors

include genetic and metabolic conditions, high lipid diet, low intake of antioxidant agents, and inadequate physical exercise [7].

Periodontitis is a chronic infection of the periodontium which is predominantly associated with anaerobic gram-negative bacteria present as microbial biofilm on the tooth surface. It is a disease entity resulting from an inflammatory reaction of the periodontal tissues to bacterial plaque, leading to irreversible destruction of the connective tissue attachment and alveolar bone resorption, and eventual tooth loss [8, 9]. Several risk factors have been associated with periodontitis, hyperlipidemia and its fractions have attracted recent attention [10, 11]. Studies show that the global prevalence of periodontitis in its mild or moderate forms ranges from 13% to 57% in different populations. Globally, the severe form of the disease has a prevalence of 11%9. Olagundoye and co-workers reported a prevalence of 68.5% in a Nigerian study [12].

A causal relationship has been demonstrated between high serum lipid levels and periodontitis [13]. Hyperlipidemia has a negative effect on immunocompetent cells and wound healing, as a result, it predisposes to periodontitis and other infections [14]. It also causes dysfunction/overactivity of the polymorphonuclear leucocytes, and elaboration of reactive oxygen radicals which causes basement membrane permeability by damaging the endotheliocytes and subendothelial zone [14].

Studies have demonstrated a significantly higher level of Total serum Cholesterol and Low-density lipoproteins (LDL) among the patients suffering from periodontitis than the control group [15, 16], this they suggested can occur as a result of cytokines such as tumor necrosis factor α (TNF-α) and interleukin 1 β (IL-1β) produced in response to gram-negative lipopolysaccharides. These cytokines are thought to affect lipid metabolism by influencing the production of other cytokines, altering the hemodynamics and amino acid utilization of tissues involved in lipid metabolism [17]. A study also reported that the administration of statins improved the PD and CAL of patients [18] as it suppresses IL-6, TNF-α, IL-1β, periodontal microorganisms such as *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans* and secretion of matrix metalloproteinases.

It was suggested that periodontal infections might also modify the hypothalamic-pituitary-adrenal axis thereby increasing the plasma concentration of adrenocorticotropic hormone, cortisol, adrenaline, noradrenaline, and glucagon [19]. All these results in increased hepatic lipid production and increased adipose tissue lipolysis and blood flow. It also enhanced the synthesis and reduced clearance of triglycerides, and increased the synthesis of LDL as a result of decreased lipoprotein lipase activity [14]. The aim of this study is to investigate the relationship between lipid profile and the severity of periodontitis in the subjects. It is also to assess the lipid profile and intraoral parameters such as simplified oral hygiene index, clinical attachment loss, pocket depth, and periodontal destruction index of subjects in the study.

METHODS

This study was conducted at the family Medicine clinic of the Obafemi Awolowo University Teaching Hospital (OAUTHC) Ile-Ife. OAUTHC provides health services to Osun state and its environs including Ondo, Ekiti, and some parts of Oyo and Kwara states. The study was cross-sectional with the subjects drawn via convenient sampling.

Patients included in this study were those that gave their consent and are aged between 18 and 60 years. African descents with at least 10 teeth present in the mouth [20]. Patients who are non-smokers and not on antibiotics, steroids, statins, or other lipid-lowering drugs. Patients who are not pregnant and not currently on periodontal treatment were also included. Patients who had scaling and polishing done in the last 6 months or have been diagnosed with systemic diseases such as diabetes mellitus, coronary artery disease, myocardial infarction, lipid disorders, and any immune compromising disease were excluded.

Ethical clearance for this study was granted by the Ethical Committee of the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-Ife and written consent was signed by each subject in the study before data collection. Data collection was done using a self-administered questionnaire which consisted of both open and closed-ended questions to obtain information on age, sex, occupation, medical history, and dental history.

The subject parameters i.e, indices for extent and severity of periodontitis measurements using William's periodontal probe to determine the probing depths and clinical attachment loss at sites around each tooth, periodontal disease index, and simplified oral hygiene index were also estimated.

Blood lipid profile was also recorded by collecting 5ml of blood from the patient via the antecubital vein while observing appropriate infection control methods. The sample was sent to the Chemical Pathology laboratory in the Department of Pathology of the Obafemi Awolowo University Teaching Hospital Ile-Ife for analysis, High-density lipoprotein (HDL), Triglycerides (TG), and total blood cholesterol were estimated by spectrophotometry after titrating each sample with Fortress diagnostic kit (Fortress diagnostics limited United Kingdom). The value of the low-density lipoproteins (LDL) was estimated using the Friedwald equation [21]

Data analysis was carried out using Stata 10(StataCorp College Station, Texas). Descriptive statistics was carried out for socio-demographic variables such as age and occupation. For descriptive variables that are continuous, mean, minimum, and maximum and measures of variability were determined. For descriptive variables that are categorical, simple frequency and percentages was determined. The prevalence of periodontitis in the subjects was determined statistically using the likelihood chi-square, this was also done for occupation and severity of the disease.

Bivariate analysis was done using a two-way t-test for the mean values of the intraoral parameters and blood cholesterol parameters to test for a significant difference. Multivariate logistic regression method for repeated data was used to determine the effect of covariates in the prevalence of periodontitis and to adjust for confounders including sex. Statistical significance will be inferred at $p \leq 0.05$.

RESULTS

A total of 195 subjects were included in the study, males constituted 76 (38.97%) and females 119(61.03%). Age range was 18 -60 years, while the mean age was 37.42±12.95, the largest population were subjects aged 33-49 years 54(27.69%) (Figure 1). Figure 2 shows the distribution of the subjects according to their occupation, unskilled workers formed a large proportion of the subjects in this study 69 (34.5%), the unemployed/students population is next 60 (30.77%), and the least were the retirees (2.1%).

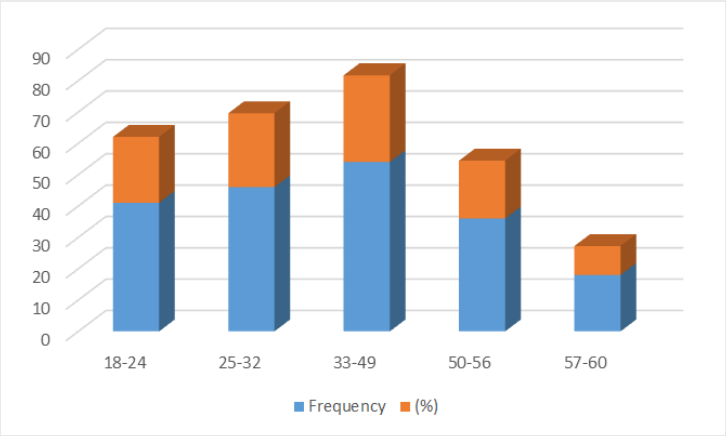

Figure 1: Age Distribution of the Subjects

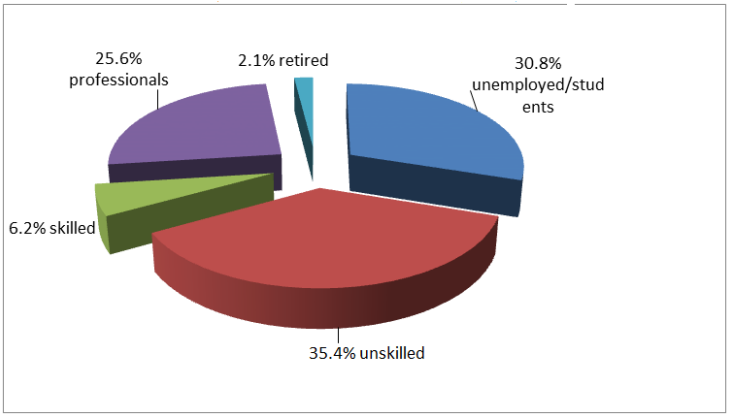

Figure 2: Distribution of the Subjects by Occupation

The mean total cholesterol was 4.28± (1.02) in the subjects, and the LDL/HDL in the subjects has a mean of 3.43(±4.01). The mean triglycerides, LDL, and HDL in the subjects were 1.15(±0.71), 2.51(±1.04), and 1.21(±0.60) respectively, while the mean OHI was 3.21(±1.25), the mean CAL was 1.81 (±1.41), mean PD was 2.66 (±0.90), and the mean PDI was 2.30 (±1.33).

The prevalence of periodontitis among the subjects in this study was 68.7%. Prevalence of periodontitis was lower amongst the males (40.30%) than the females (59.70%) but this difference is not statistically significant ($p>0.05$). Using a likelihood-ratio chi-square, there was a significant relationship between the occupation of the subjects and the prevalence of periodontitis $p=0.001$. More of the unskilled subjects in the study have periodontitis with a prevalence of 44.78%, while the least prevalence was among the retirees (2.05%) (Table 1).

Table 1: Prevalence of Periodontitis by Occupation in the Subjects

Occupation	Periodontitis in all the subjects n/(%)		Total n/(%)
	Absent	Present	
Unemployed	37 (60.66)	22 (16.42)	59 (30.26)
Unskilled	9 (14.75)	60 (44.78)	69 (35.39)
Skilled	3 (4.92)	9 (6.72)	12 (6.15)
Professional	10 (16.39)	41 (30.60)	51 (26.15)
Retiree	2 (3.28)	2 (1.49)	4 (2.05)
Total	61 (100)	134 (100)	195 (100)

Likelihood ratio chi^2 = 37.2870 p<0.001*

Table 2: Bivariate Analysis of Mean CAL, PD, and PDI and the Lipid Profile

Variable	N	CAL		PD		PDI	
		Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value
Total cholesterol (mmol/l)							
<6.1	188	1.84(1.44)	0.17	2.66(0.91)	0.63	2.37(1.35)	0.01*
≥6.1	7	1.15(1.05)		2.79(0.76)			
Triglycerides (mmol/l)							
<2.2	170	1.92(1.44)	0.01*	2.71(0.92)	0.02*	2.38(1.33)	0.13
≥2.2	25	1.09(1.13)		2.34(0.74)		1.93(1.38)	
HDL (mmol/l)							
>1.5	65	1.41(1.30)	0.01*	2.39(0.54)	0.01*	2.26(1.21)	0.77
≤1.5	130	2.02(1.46)		2.80(1.01)		2.36(1.41)	
LDL (mmol/l)							
<3.3	154	1.75(1.41)	0.21	2.61(0.83)	0.10	2.29(1.33)	0.57
≥3.3	41	2.07(1.50)		2.86(1.13)		2.43(1.42)	
LDL/HDL							
<3.2	144	1.78(1.42)	0.59	2.60(0.80)	0.12	2.32(1.29)	0.70
≥3.2	51	1.90(1.48)		2.77(1.14)		2.34(1.50)	

*significant

Using a two-way t-test there was a statistically significant difference in the mean CAL and mean PD for triglycerides and HDL, but this was not true for total cholesterol, LDL and LDL/HDL (p>0.05), while only the mean PDI for total cholesterol had statistically significant difference (p<0.05) (Table 2). Logistic regression revealed that age OR(1.17) CI(1.05,1.13), socioeconomic status OR(20.20) CI(0.87,2.17), and OHI OR(2.64) CI(1.12,6.25) have a significant association with periodontitis in males p≤0.05. While in females age OR(1.10) CI(1.05,1.15) and total cholesterol OR(1.86) CI(0.51,6.84) were significantly associated p≤0.05 (Table 3).

Table 3: Logistic Regression for Assessment of the Covariates and Periodontitis Controlling For Gender

Variable	Male				Female			
			Confidence interval				Confidence interval	
	Odds ratio	P-value	Lower	Upper	Odds ratio	P-value	lower	upper
Age	1.17	0.01*	1.05	1.33	1.10	0.01*	1.05	1.15
Socioeconomic class (occupation)	20.20	0.03*	0.87	47.7	2.17	0.43	0.43	11.03
Total cholesterol	0.60	0.60	0.08	4.27	1.86	0.01*	0.51	6.84
OHI	2.64	0.03*	1.12	6.25	1.29	0.30	1.80	2.06

N =195

Likelihood ratio chi^2 of the model = 73.52

P= 0.001*

* significant

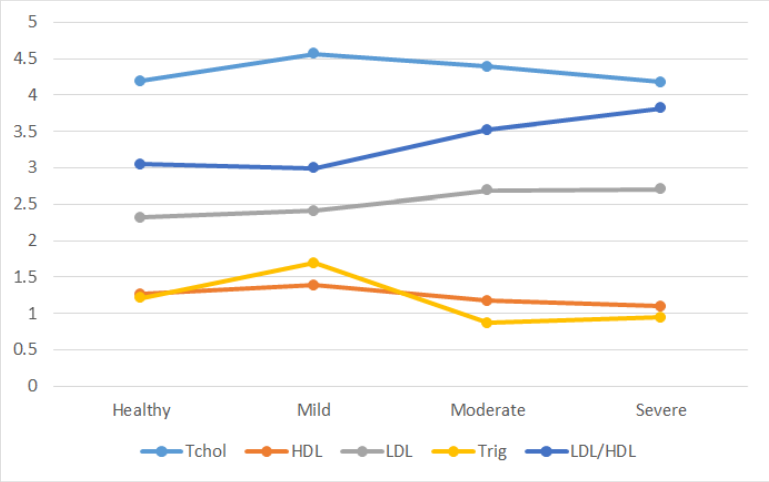

Figure 3: Lipid Profile and the Severity of Periodontitis

Figure 3 shows that mean total cholesterol was highest for mild periodontitis 4.57 (±0.87) and least for severe 4.18 (±1.02). The mean HDL was higher for the healthy periodontium at 1.27 (±0.67) and mild at 1.39 (±0.69) and lower for moderate at 1.17 (±0.53) and severe at 1.10 (±0.53). The mean LDL was higher for moderate 2.69 (±0.99) and severe periodontitis 2.71 (±0.98) while it was lower for healthy periodontium 2.32 (±1.16) and mild periodontitis 2.41(±1.00). The mean triglycerides was lower for moderate 0.87 (±0.46) and severe periodontitis 0.95 (±0.53) while it was higher for the healthy periodontium 1.21 (±0.71) and mild periodontitis 1.69 (±0.91). The mean LDL/HDL was 3.15 (±4.20) for the healthy periodontium, however, there was a linear relationship for mild 3.00 (±4.05), moderate 3.52 (±3.46) and severe periodontitis 3.82 (±4.18).

DISCUSSION

A large proportion of the subjects were unskilled workers 69 (35.4%) and students/unemployed 60(30.8%), this is probably because of the location of the study which is a semi-urban settlement, and because there are two Universities in the location of this study. The retiree population in this study 4 (2.1%) was the least and this is because of the age selection criteria that limit the upper limit to 60 years and probably because many of them are old and cannot easily get to the hospital for treatment, this further emphasises the need for home-based treatment and visitation by health workers for this age group as it is done elsewhere [22], reported tremendous success in health provisions to the elderly and the handicapped in the United States of America in a randomised controlled study.

Averagely, subjects in this study had poor oral hygiene with a mean OHI of 3.21 (±1.26). This is in consonance with the fact that a large percentage of the subjects in this study were of low socioeconomic status, it may also be due to poor oral health awareness which is common in the location of this study [23]. This result is consistent with a study [24] that associated low income and poor oral hygiene in Bangladesh.

The mean CAL of 1.81 (±1.41) mm signifies a preponderance of moderate periodontitis in the study this is inconsistent with a similar study but with a larger sample size in South Korea (mean CAL 2.42mm) [25]. The prevalence varied with the occupation of the subjects, the unskilled had the highest prevalence of periodontitis of 44.78%, and this is because most of them are of low the socioeconomic group. The unemployed/students had a lower prevalence of 16.42%, this is because many of them are young, educated, and most likely more aesthetic and health-conscious than other occupational groups. The professional group has a prevalence of 30.60%, this result is comparable with a study at Ibadan Nigeria [26] where reasons such as busy schedule and stress were adduced, a further study is needed to elucidate this.

The relationship between HDL, LDL, and severity of periodontitis in this study followed the trend of other chronic illnesses [27, 28]. HDL was higher in the healthy subjects and those with mild periodontitis, and lower in the moderate and severe periodontitis. LDL was higher in subjects with moderate and severe periodontitis and lower in the healthy subjects and those with periodontitis. Increase in LDL/HDL has a linear relationship with the severity of periodontitis from mild to severe.

CONCLUSION

Age and oral hygiene were significant risk factors for periodontitis in this study regardless of gender. While socioeconomic status was a significant factor in males, high lipid profile was significantly associated with periodontitis in females in females. This requires that oral health education should be intensified across gender, all age groups, and socioeconomic status. Governments and policymakers should also put in place mechanisms that will improve the socioeconomic status and well-being of the people.

Patients should be advised to have regular medical check-ups including investigations for blood lipids to reduce their risk of many chronic diseases including periodontitis. Home visits by social workers and community health personnel should be emphasized; this will make provisions for the aged and handicapped that cannot easily access health facilities. Further studies will be required to establish the cause-effect relationship between blood lipids and the severity of periodontitis.

Conflict of interest: None

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