ORIGINAL ARTICLE

Relationship between obesity and oral diseases

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Abstract

Objective: The aim of this study was to determine the relationship between obesity and periodontal status and dental caries experience of a group of Nigerian dental patients.

Materials and Methods: Participants were selected from patients attending dental outpatient clinics of the University of Benin Teaching Hospital, Benin City, Nigeria. Their weight and height were measured and body mass index (BMI) estimated in kg/m^2, gingival health assessed using bleeding on probing index, oral hygiene estimated using the simplified oral hygiene index (OHI-S), periodontal health estimated using the basic periodontal examination (BPE) and caries experience was estimated with the decayed, missing, and filled teeth (DMFT) index.

Results: A few participants (3.8%) were underweight, 52.6% fell within the normal BMI range, 28.2% preobese, 12.2% obese class I and 3.2% obese class II. The mean OHI-S score was 2.16 ± 1.13 among the overweight participants and 2.05 ± 1.13 among those who are not (P = 0.543). The mean DMFT score was 3.03 ± 4.25 among the overweight participants and 2.32 ± 3.01 among those who are not (P = 0.223). Sixty-five percent of participants with BPE score of 0, considered to signify periodontal health, had normal BMI while all the participants with the worst BPE score recorded belong to the obese 1 group (P = 0.070). The binary logistic regression revealed that the likely predictor of gingival bleeding in the study is BMI between 35.0 and 39.9 (obese class 2) (P = 0.046, odds ratio = 0.07, 95% confidence interval = 0.01-0.96).

Conclusion: It can be concluded from this study that there is no statistically significant relationship between obesity and periodontal status and dental caries experience in the studied group of dental patients. Increased BMI may however be a predictor of gingival bleeding.

Key words: Dental caries, obesity, periodontal disease

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Introduction

Obesity is defined as an abnormal or excessive fat accumulation that may impair health and its objective measure is a body mass index (BMI) ≥30.[1] Obesity in Nigeria is increasing and is now considered of epidemic proportions.[2,3] A systematic review of studies to determine the prevalence of overweight and obesity in adult Nigerians reported that the prevalence of obesity ranged from 8.1% to 22.2%, respectively.[3] It is believed in some quarters that because obesity is culturally and socially acceptable among Nigerians, it may not be treated as a medical problem. This makes it more of public health importance.[4]

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According to the World Health Organization (WHO), dental caries and periodontal diseases are very common oral diseases.[5] Worldwide, 60-90% of school children and nearly 100% of adults have dental cavities while severe periodontal disease is found in 15-20% of middle-aged adults.[5] Studies on caries experience in Nigeria reported prevalence lower than what WHO reported,[6,7] but an increasing caries trend has been observed.[6] Reasons suggested for this new trend include increased consumption of cariogenic diet, poor knowledge of oral health, and poor utilization of oral health care services.[6] Periodontal disease is highly prevalent in

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Nigeria with potentially high burden of disease.[8,9] It has been reported that periodontal disease with deep pocketing occurs in Nigerians at an early age, the prevalence being 15-58%.[8]

A biologically plausible role for obesity in the development of periodontal disease has been reported.[10] It has been suggested that the relationship between obesity and periodontal disease may be bi-directional.[10,11] The adipose tissue in obesity is said to actively secrete a variety of cytokines and hormones that are involved in inflammatory processes, pointing toward similar pathways involved in the pathophysiology of obesity, periodontitis, and related inflammatory diseases.[12]

A relationship between obesity and dental caries has also be reported,[13,14] although the effect of confounders such as age, socioeconomic status, country of origin (industrialized or nonindustrialized) and type of dentition (deciduous or permanent) is still not very clear.[13]

A previous study was done to determine overweight and obesity among patients attending a Nigerian oral surgery clinic,[15] but a link has not been established between obesity and oral diseases. The aim of this study was therefore to determine the relationship between obesity and periodontal status and dental caries experience of a group of Nigerian dental patients, taking into consideration the other risk factors of periodontal disease and dental caries.

Materials and Methods

The study participants were willing patients consecutively recruited from the dental outpatient clinics of the University of Benin Teaching Hospital, Benin City between July and November, 2013. Written informed consent was obtained from the study participants and approval to carry out the study was obtained from the Ethics and Research Committee of the College of Medicine, University of Benin.

A total of 156 participants were involved in this study. The sample size was scientifically determined using the general prevalence formula[16] and based on the prevalence of obesity of 11.4% reported by a similar study[15] done among patients attending a Nigerian oral surgery clinic. Data collected include participants' age, sex, and smoking status, highest level of education, socioeconomic status, and underlying medical condition. Information on the following oral health practices was also recorded: Use of dental floss, frequency of tooth brushing, use of fluoridated toothpaste, past dental prophylaxis, and frequency of consumption of cariogenic diet.

Based on a previous study,[17] the respondents were classified according to their occupation into five socioeconomic classes as follows: Class 1 (executives, doctors, lawyers, engineers, professors, and traditional rulers), Class 2 (civil servants, clergymen, businessmen, and pensioners), Class 3 (tailors, bricklayers, carpenters, typists, clerk, and house wife), Class 4 (messengers, roadside traders, cleaners, night-guards, and farmers), and Class 5 (students).

Clinical parameters were estimated by calibrated examiners. A pilot study was carried out and intra class correlation coefficient of 0.75 was obtained, indicating an acceptable inter-examiner agreement. The participants were weighed and their height measured. BMI was then estimated in kg/m^2 and individuals were classified according to WHO criteria[18] as follows: Underweight (<18.5), normal range (18.5-24.9), preobese (25.0-29.9), obese class I (30.0-34.9), obese class II (35.0-39.9), and obese class III (≥40).

The participants' gingival health was assessed using bleeding on probing index (BOP)[19] as follows: 1 = No gingival bleeding on probing, 2 = Gingiva bleeding on probing, 3 = Spontaneous gingival bleeding. Oral hygiene (plaque and calculus accumulation) was estimated using the simplified oral hygiene index (OHI-S).[20] The OHI-S of

Table 1: Demographic characteristics of study participants

Characteristics	*n* (%)
Age group (years)	
<25	38 (24.4)
25-44	67 (42.9)
45-64	34 (21.8)
65 and above	17 (10.9)
Gender	
Male	86 (55.1)
Female	70 (44.9)
Highest level of education	
Informal	5 (3.2)
Primary	9 (5.8)
Secondary	35 (22.4)
Tertiary	107 (68.6)
Socioeconomic class	
Class 1	13 (8.3)
Class 2	66 (42.3)
Class 3	10 (6.4)
Class 4	9 (5.8)
Class 5	58 (37.2)
Smoking status	
Yes	40 (25.6)
No	116 (74.4)
Previous dental prophylaxis	
Yes	58 (37.2)
No	98 (62.8)
Use of dental floss	
Yes	21 (13.5)
No	135 (86.5)
Consumption of cariogenic substances	
Yes	117 (75.0)
No	39 (25.0)

0-1.2 was considered good oral hygiene, 1.3-3.0 fair oral hygiene, and 3.1-6.0 poor oral hygiene.

Periodontal health was estimated using the basic periodontal examination (BPE).[21] Code 0 was given when there is no sextant with periodontal pockets exceeding 3 mm in depth, calculus, overhangs of fillings or bleeding after gentle probing, Code 1 when there is no sextant with periodontal pockets exceeding 3 mm in depth, calculus, overhangs of fillings, but there is bleeding after gentle probing, Code 2 when there is no sextant with periodontal pockets exceeding 3 mm in depth, but there is subgingival calculus or other plaque retention factors, Code 3 when the periodontal pocket depth is >3 mm but <6 mm, Code 4 when the periodontal pocket depth is 6 mm or more, Code * when there is total attachment loss at any site of 7 mm or more, or if a furcation can be probed.

The participants' caries experience was estimated with the decayed, missing, and filled teeth (DMFT) index[22] which is the total number of DMFT in each participant. A score of zero was considered normal, 1-3 within acceptable standard and >3 below an acceptable standard.

Data were analyzed using the Statistical Package for Social Sciences version 15.0 (SPSS Inc., Chicago IL.) Statistical analyses done include frequency distributions and cross-tabulation. Chi-square test was done to test the statistical significance (Likelihood ratio Chi-square was computed where frequency was <5 based on William's criterion). Comparison of the mean scores of the clinical parameters of the participants namely OHI-S and DMFT were done using independent *t*-test. To compare the mean scores, the BMI of the participants was grouped into two: Group not overweight (underweight and normal) and the overweight group (preobese, and obese class I, II, and III). The binary logistic regression was also done to determine if BMI and demographic characteristics will predict gingival bleeding, periodontal tissue loss and increasing caries experience. $P < 0.05$ was considered statistically significant.

Table 2: Relationship between the BMI of the study participants and their demographic characteristics

Characteristics	*n* (%)						χ^2	*P* value
	Underweight	Normal	Preobese	Obese 1	Obese 2	Total		
Age (years)								
<25	3 (7.9)	29 (76.3)	5 (13.2)	1 (2.6)	0 (0.0)	38 (100.0)	33.35	0.001
25-44	3 (50.0)	36 (43.9)	21 (47.7)	5 (26.3)	2 (40.0)	67 (42.9)		
45-64	0 (0.0)	11 (13.4)	11 (25.0)	10 (52.6)	2 (40.0)	34 (21.8)		
65 and above	0 (0.0)	6 (7.3)	7 (15.9)	3 (15.8)	1 (20.0)	17 (10.9)		
Sex								
Male	1 (1.2)	56 (65.1)	22 (25.6)	7 (8.1)	0 (0.0)	86 (100.0)	20.77	0.001
Female	5 (7.1)	26 (37.1)	22 (31.4)	12 (17.1)	5 (7.1)	70 (100.0)		
Education								
Informal	0 (0.0)	2 (40)	2 (40.0)	1 (20.0)	0 (0.0)	5 (100.0)	3.96	0.984
Primary	0 (0.0)	4 (44.4)	3 (33.3)	1 (11.1)	1 (11.1)	9 (100.0)		
Secondary	2 (5.7)	18 (51.4)	9 (25.7)	5 (14.3)	1 (14.3)	35 (100.0)		
Tertiary	4 (3.7)	58 (54.2)	30 (28.0)	12 (11.2)	3 (11.2)	107 (100.0)		
Socioeconomic class								
Class 1	0 (0.0)	9 (69.2)	3 (23.1)	1 (7.7)	0 (0.0)	13 (100.0)	28.05	0.031
Class 2	2 (3.0)	28 (42.2)	24 (36.4)	8 (12.1)	4 (6.7)	66 (100.0)		
Class 3	0 (0.0)	4 (40.0)	2 (20.0)	3 (30.03)	1 (10.0)	10 (100.0)		
Class 4	0 (0.0)	2 (22.2)	4 (44.4)	3 (33.3)	0 (0.0)	9 (100.0)		
Class 5	4 (6.9)	39 (67.2)	11 (19.0)	4 (6.9)	0 (0.0)	58 (100.0)		
Smoking status								
Yes	0 (0.0)	6 (60.0)	2 (20.0)	2 (20.0)	0 (0.0)	10 (100.0)	2.30	0.680
No	6 (4.1)	76 (52.1)	42 (28.8)	17 (11.6)	5 (3.4)	146 (100.0)		
Previous dental prophylaxis								
Yes	0 (0.0)	26 (44.8)	22 (37.9)	9 (15.5)	1 (1.7)	58 (100.0)	11.16	0.025
No	6 (6.1)	56 (57.1)	22 (22.4)	10 (10.2)	4 (4.1)	98 (100.0)		
Use of dental floss								
Yes	0 (0.0)	10 (47.6)	6 (28.6)	4 (19.0)	1 (4.8)	21 (100.0)	2.84	0.585
No	6 (4.4)	72 (53.3)	38 (28.1)	15 (11.1)	4 (3.0)	135 (100.0)		
Consumption of cariogenic substances								
Yes	6 (5.1)	64 (54.7)	30 (25.6)	14 (12.0)	3 (3.6)	117 (100.0)	5.46	0.243
No	0 (0.0)	18 (46.2)	14 (35.9)	5 (12.8)	2 (5.1)	39 (100.0)		

BMI=Body mass index

Results

A total of 156 participants were included in this study, with a male: Female ratio of 1.2:1. The majority had a tertiary level of education (68.6%), nonsmokers (74.4%), had no previous dental prophylaxis (62.8%), and did not floss their teeth (86.5), but consume cariogenic substances such as sweets, chocolate, and biscuits regularly (75.0%) [Table 1].

A few participants (3.8%) were underweight, 52.6% fell within the normal BMI range, 28.2% preobese, 12.2% obese class I, and 3.2% obese class II [Table 2]. The majority (76.3%) of the participants under 25 years had normal BMI values while the majority (52.6%) in the 45-64 age group had obese class 1 BMI values ($P = 0.001$). More females were overweight/obese than males ($P = 0.001$) and more persons were overweight among those with informal education ($P = 0.984$), those who belong to the socioeconomic class 4 ($P = 0.031$) and among those who claim not to consume cariogenic substances at all ($P = 0.243$) [Table 2].

The mean OHI-S score was 2.16 ± 1.13 among the overweight participants and 2.05 ± 1.13 among those who are not ($P = 0.543$). The mean DMFT score was 3.03 ± 4.25 among the overweight participants and 2.32 ± 3.01 among those who are not ($P = 0.223$). There was no statistically significant difference between the frequency of the five BMI groups within each group of BOP, OHI-S, BPE, and DMFT [Table 3]. Absence of bleeding from the gingiva, good oral hygiene and DMFT of zero was recorded in 55.4%, 58.3%, and 60.4% of participants with normal BMI respectively [Table 3]. Sixty-five percent of participant with BPE score of 0, considered to signify periodontal health, had normal BMI, while all the participants with the worst BPE score recorded belong to the obese 1 group ($P = 0.070$) [Table 3].

The binary logistic regression revealed that the likely predictor of gingival bleeding in the study is BMI between 35.0 and 39.9 (obese class 2) ($P = 0.046$, odds ratio [OR] =0.07, 95% confidence interval [CI] =0.01-0.96) [Table 4], while the predictors for periodontal tissue loss are age group 25-44 years ($P = 0.044$, OR = 5.70, 95% CI = 1.05-31.01) and 65 years and above ($P = 0.050$, OR = 5.43, 95% CI = 1.00-29.61) as well as socioeconomic class 3 ($P = 0.032$, OR = 3.53, 95% CI = 1.11–11.17) and class 4 ($P = 0.035$, OR = 0.14, 95% CI = 0.02-5.75) [Table 5]. Age between 45 and 64 years ($P = 0.034$, OR = 0.21, 95% CI = 0.05–0.89) as well as female gender ($P = 0.018$, OR = 3.15, 95% CI = 0.05-1.19) are likely predictors for increased caries experience in this study [Table 6].

Discussion

The percentage of people whose BMI was above normal (i.e., >24.9) in this study (43.6%) was slightly more than the 39.1% previously reported in a group of Nigerian dental patients.[15] The obese groups (I and II) made up 15.4% and this is also higher than the 11.4% previously reported.[15] However, these Nigerian figures are still lower than what was reported in developed countries.[23,24] This may be connected with the new technologies available in the

Table 3: Relationship between the oral health clinical parameters and the BMI of the study participants

Clinical Parameters	*n* (%)						χ^2	*P* value
	Underweight	Normal	Preobese	Obese 1	Obese 2	Total		
BOP score								
No bleeding	2 (2.7)	41 (55.4)	20 (27.0)	10 (13.5)	1 (1.4)	74 (100.0)	3.70	0.883
Bleeding on probing	4 (5.0)	40 (50.0)	23 (28.8)	9 (11.3)	4 (5.0)	80 (100.0)		
Spontaneous bleeding	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	2 (100.0)		
OHI-S								
Good	1 (2.1)	28 (58.3)	15 (31.3)	3 (6.3)	1 (2.1)	48 (100.0)	5.83	0.666
Fair	3 (3.8)	43 (53.8)	20 (25.0)	11 (13.8)	3 (3.8)	80 (100.0)		
Poor	2 (7.1)	11 (39.3)	9 (32.1)	5 (12.9)	1 (3.6)	28 (100.0)		
BPE score								
0	1 (5.0)	13 (65.0)	5 (25.0)	1 (5.0)	0 (0.0)	20 (100.0)	25.01	0.070
1	0 (0.0)	10 (43.5)	12 (52.2)	1 (4.3)	0 (0.0)	23 (100.0)		
2	2 (2.7)	39 (52.0)	18 (24.0)	12 (16.0)	4 (5.3)	75 (100.0)		
3	3 (8.3)	20 (55.6)	9 (25.0)	3 (8.3)	1 (2.8)	36 (100.0)		
4	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)		
DMFT score								
0	1 (2.1)	29 (60.4)	10 (20.8)	6 (12.5)	2 (4.2)	48 (100.0)	5.91	0.657
1-3	4 (5.8)	36 (52.2)	18 (26.1)	9 (13.0)	2 (2.9)	69 (100.0)		
>3	1 (2.6)	17 (43.6)	16 (41.0)	4 (10.3)	1 (2.6)	39 (100.0)		

BOP=Bleeding on probing; OHI-S=Simplified oral hygiene index; BPE=Basic periodontal examination; DMFT=Decayed, missing and filled teeth; BMI=Body mass index

Table 4: Logistic regression predicting participants' gingival bleeding from their demographic characteristics and BMI

Predictor	Gingival bleeding			
	Wald χ^2	*P* value	OR	95% CI
Age group (years)				
25-44	0.03	0.861	1.15	0.24-5.65
45-64	0.15	0.695	1.33	0.32-5.55
65 and above	0.46	0.499	1.71	0.36-8.05
Gender				
Female	0.37	0.545	0.78	0.35-1.75
Level of education				
Primary	0.01	0.999	2E+009	0.00
Secondary	0.34	0.599	1.65	0.31-8.83
Tertiary	0.06	0.813	1.12	0.44-2.89
Social class				
Class 2	1.11	0.292	2.15	0.52-8.93
Class 3	1.86	0.173	0.53	0.21-1.32
Class 4	0.02	0.894	0.89	0.17-4.70
Class 5	0.01	0.999	1E+009	0.00–
Smoking				
No	0.17	0.679	1.37	0.31-6.13
Prophylaxis				
No	0.63	0.427	1.36	0.64-2.92
Use of floss				
No	0.06	0.812	1.14	0.38-3.40
Cariogenic substances				
No	0.01	0.991	1.01	0.40-2.55
BMI				
Normal	0.41	0.522	0.39	0.02-7.05
Preobese	2.34	0.126	0.16	0.01-1.69
Obese class 1	1.81	0.179	0.20	0.02-2.11
Obese class 2	3.97	0.046*	0.07	0.01-0.96

Reference points: Age ≤25 years; Gender=Male; Level of education=Informal; Socioeconomic class=Class 1; Smoking=Yes; Previous dental prophylaxis=Yes; Use of floss=Yes; Consumption of cariogenic substances=Yes; BMI=Underweight. BMI=Body mass index; CI=Confidence interval; OR=Odds ratio *P<0.05 is statistically significant

developed countries which encourage sedentary lifestyle[24] as well as a diet dominated by higher intake of fats and lower intake of fiber.[25]

Women have been reported to be more obese than males.[15,23,24] The result of this study also supports this. Obese class II, the highest range of BMI reported in this study consisted only of women. The reason for this may be the cultural belief that weight gain in a woman is a sign of affluence and a sign that the woman is well taken care of.[26] Obese women are actually considered more attractive and desirable in some cultures.[27] Obesity may also be commoner in women because of the gender differences in fat metabolism.[28]

It was found that the higher level of education, the more likely it is to adopt a healthier lifestyle, resulting in healthier BMI.[29] Although, the effect of education on BMI was not statistically significant in this study, the result in a way supports of the findings of this previous study, as more people who did not have any formal education were found to be overweight. High socioeconomic level is also expected to translate to better education and invariably better lifestyle options.[30] It is therefore not surprising that more overweight persons in this study belong to the lower socioeconomic class. What is surprising is that more people who claimed not to consume cariogenic food substances, which are potentially fattening, were overweight. It is however possible that the overweight people tend to avoid frequent consumption of the cariogenic diet as a preventive measure since "binge eating" has been linked to obesity.[31]

Obesity has been reported to have a serious impact on health status generally. This impact is said to have the same outcome as 20 years of aging and to even exceed that of smoking or alcohol abuse.[32] It has been postulated that increasing body fat may stimulate a hyper inflammatory response in periodontal disease[33] and that obesity may have the potential for transforming the host's immunity and inflammatory system, causing the patient to be more at risk to the effects of microbial plaque.[34] Studies have shown deeper periodontal pocket in obese patients.[32,34] Obesity was reported to be an independent predictor of poor response following nonsurgical periodontal therapy.[34] In this study, all persons who had the worst BPE score of 4 were obese although this pattern was not statistically significant. This result is similar to a previous one where the relationships between obesity and periodontal tissue loss did not reach statistical significance.[35]

Increased BMI has been associated with increased gingival bleeding.[33] This may be because BMI has a positive relationship with pro-inflammatory markers and inverse relationship with antioxidants.[36] However, this study does not seem to support this assertion as none of the obese persons in this study had spontaneous gingival bleeding.

Previous studies on the relationship between BMI and caries experience revealed that obesity and overweight increased prevalence of dental caries in both primary and permanent dentition in children.[37] This may be connected with lifestyle and dietary habits. However, another study also done among children, in the same environment as this study, expressed a contrary view.[38] The mean DMFT score of this study's participants who are not overweight is less than that of those who are overweight. The mean DMFT score among the overweight group in this study is 3.03 ± 4.25 and is to a very large extent still lower than the mean of 16.06 ± 6.29 reported among obese patients in a developed country.[39] However, this result should be a source of concern as it is greater than the global average of 3 DMFT which is the set goal of WHO and the foreign direct investment World Dental Federation.[5]

Table 5: Logistic regression predicting participants' periodontal attachment loss from their demographic characteristics and BMI

Predictor	Periodontal attachment loss			
	Wald χ^2	P value	OR	95% CI
Age group (years)				
25-44	4.05	0.044*	5.70	1.05-31.01
45-64	2.99	0.084	3.54	0.85-14.83
65 and above	3.86	0.050*	5.45	1.00-29.61
Gender				
Female	0.30	0.585	1.37	0.50-3.42
Level of education				
Primary	0.04	0.846	0.78	0.07-9.13
Secondary	0.67	0.412	2.96	0.22-39.46
Tertiary	1.03	0.311	1.87	0.56-6.26
Social class				
Class 2	0.32	0.859	1.16	0.23-5.75
Class 3	4.60	0.032*	3.53	1.11-11.17
Class 4	4.43	0.035*	0.14	0.02-0.87
Class 5	1.02	0.313	0.36	0.05-2.64
Smoking				
No	0.92	0.337	0.30	0.03-2.64
Prophylaxis				
No	0.01	0.937	1.04	0.41-2.63
Use of floss				
No	0.81	0.368	0.50	0.11-2.24
Cariogenic substances				
No	0.27	0.607	0.76	0.26-2.18
BMI				
Normal	1.17	0.280	0.12	0.01-5.51
Preobese	0.09	0.764	0.58	0.02-19.61
Obese class 1	0.01	0.946	0.89	0.03-29.72
Obese class 2	0.02	0.360	0.79	0.02-30.24

Reference points: Age ≤25 years; Gender=Male; Level of education=Informal; Socioeconomic class=Class 1; Smoking=Yes; Previous dental prophylaxis=Yes; Use of floss=Yes; Consumption of cariogenic substances=Yes; BMI=Underweight. BMI=Body mass index; CI=Confidence interval; OR=Odds ratio *P<0.05 is statistically significant

Table 6: Logistic regression predicting participants' increased caries experience from their demographic characteristics and BMI

Predictor	Increased caries experience			
	Wald χ^2	*P* value	OR	95% CI
Age group (years)				
25-44	2.61	0.106	0.24	0.04-1.36
45-64	4.51	0.034*	0.21	0.05-0.89
65 and above	3.03	0.082	0.25	0.05-1.19
Gender				
Female	5.57	0.018*	3.15	1.22-8.19
Level of education				
Primary	1.33	0.249	4.73	0.34-66.31
Secondary	0.77	0.380	0.34	0.03-3.85
Tertiary	0.20	0.654	1.29	0.42-3.99
Social class				
Class 2	1.70	0.192	3.19	0.56-18.21
Class 3	3.74	0.053	3.26	0.98-10.81
Class 4	1.19	0.276	2.92	0.43-20.16
Class 5	0.01	0.999	0.00	0.00–
Smoking				
No	0.15	0.700	1.57	0.16-15.58
Prophylaxis				
No	0.34	0.562	0.76	0.30-1.91
Use of floss				
No	0.33	0.567	1.46	0.40-5.30
Cariogenic substances				
No	0.31	0.576	0.74	0.25-2.16
BMI				
Normal	0.23	0.631	2.30	0.08-69.50
Preobese	0.91	0.339	3.66	0.26-52.22
Obese class 1	1.70	0.193	5.79	0.41-81.36
Obese class 2	0.30	0.584	2.24	0.13-39.71

Reference points: Age ≤25 years; Gender=Male; Level of education=Informal; Socioeconomic class=Class 1; Smoking=Yes; Previous dental prophylaxis=Yes; Use of floss=Yes; Consumption of cariogenic substances=Yes; BMI=Underweight. BMI=Body mass index; CI=Confidence interval; OR=Odds ratio *P<0.05 is statistically significant

Other than increased BMI, poor oral hygiene and the individual's demographic characteristics, medical conditions as well as habits have been extensively reported to be a predictor of both dental caries and periodontal diseases.[40] This study revealed that increased BMI is a likely predictor of gingival bleeding. This is supporting the link that has been suggested to exist between pro-inflammatory cells and adipose tissues.[36] But not of periodontal tissue destruction and increased caries experience. Increasing age and lower socioeconomic class were however found to be predictive of periodontal tissue destruction while increasing age and female gender were predictive of increased caries experience.

It has been reported that the causal relationship between obesity and periodontitis is still uncertain although many possible mechanisms have been suggested.[41] Adipose tissue derived cytokines and hormones such as leptin, resistin, and adiponectin have been strongly implicated, but their roles are yet to be fully defined.[12,42,43] This study did not identify obesity as a predictor for periodontal diseases, but increasing age and low socioeconomic class were likely predictors. This finding supports the report of a previous study that younger age was predictive of regression of initial periodontitis[44] and it also supports other findings that periodontitis is likely to occur among the poor who reside in a disadvantaged neighborhood[45] and that periodontitis is worse in the group with the worse social indicators.[46]

Increasing age was found to be predictive of increased caries experience in this study. This is supporting the earlier finding that the percentage of caries free teeth in older persons was on the decline.[47] Older persons will however be more susceptible to root caries because they are prone to root exposure, which may be due to physiologic retraction of the

gingiva or trauma to gingiva as a result of poor oral hygiene habits, periodontal diseases or treatment of such diseases.[48]

Females have been reported to have a significantly higher caries experience than males.[49] In this study, female gender was also a likely predictor of increased caries experience. This gender difference may be attributed to the difference in the diet and eating pattern[50] as well as the difference in the time of tooth eruption in both sexes.[51]

Conclusion

It can be concluded from this study that there is no statistically significant relationship between obesity and periodontal status and dental caries experience in the studied group of dental patients. Increased BMI may however be a predictor of gingival bleeding.

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