Original Article

Associations of Untreated Caries and Experience among WHO-Recommended Adult Age Groups

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Abstract

Background: The shift in caries burden from children to adults and its rise among this population necessitates epidemiological studies to provide data on the trend and modifiable factors. **Aim:** This study aimed to determine prevalence of untreated caries, its contribution to caries experience, and related factors among WHO-recommended adult age groups. **Patients, Materials and Methods:** A cross-sectional study was conducted over a six-month period in 2021 among 451 adults recruited from a patient population in Northeast Nigeria. Sociodemographic characteristics and oral health practices were recorded. Intraoral assessment for untreated caries, filled, and missing teeth were carried out according to the WHO criteria. Data analysis included logistic regression to produce a model for predictive risk for caries, with emphasis on the WHO recommended adult age groups. **Results:** The prevalence of untreated caries (81.6%) was significantly ($P < 0.05$) related to age, occupation, education, dental visits, snacking, and toothbrushing frequency. It accounted for 65.7% of the overall decayed, missing, and filled teeth score (3.35 ± 3.00) and was significantly higher for participants <25 years ($P = 0.044$) compared to the middle aged (35–44 years) and elderly (65–74 years), class III occupation ($P = 0.020$), no formal education ($P = 0.002$), and irregular dental visits ($P = 0.019$). Occupation ($\beta = 0.131$, $P = 0.016$) and level of education ($\beta = -0.132$, $P = 0.006$) were significant predictors of dental caries occurrence. **Conclusion:** Caries experience was low, but the prevalence of untreated caries was very high and more common among younger adults. Socioeconomic status was an important determinant of caries presence.

Keywords: Caries experience, caries severity, dental caries, DMFT index, untreated caries

Introduction

Dental caries affects varying population proportions globally with reported recent increases in prevalence.[1] The disease is common across all age groups, but most epidemiological studies on caries are among children and adolescents, with little attention to its prevalence and modifiers among adults. Its prevalence and burden among adults is currently high and generating concerns.[2] The impact among adults in terms of functional impairment, financial and societal costs, and quality of life has been stressed.[3] One major area of functional impairment is tooth loss from caries.[4] The importance of this effect of caries is seen in the WHO and Federation Dentaire Internationale's joint inclusion of its prevention among goals to be achieved to reduce tooth loss and edentulousness among recommended adult age groups.[5]

Socioeconomic and environmental factors, availability of oral health services, and modifiable oral health behaviours are important in epidemiological studies of caries. They are determinants of caries risk that could contribute to differences in prevalence among populations. Thus, the need to assess population characteristics to form the basis for preventive strategies particular to the population studied and also to provide a reference data base for monitoring the trend of the disease. Epidemiological studies on caries among adults are scarce in Nigeria. Available data show prevalence ranges between 3% and 85% with the highest recorded decayed, missing, and filled teeth (DMFT) index at 3.57 among adults

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in the Southern part of the country.[4,6-9] The WHO listed Nigeria as a country with very low (<5.0) DMFT among 35–44-year-old adults in its world map report on dental caries in 2003.[10] Since this report, there has been evidence that the global age-standardized prevalence and incidence of untreated caries is increasing and remains high.

Considering the foregoing, this study had objectives to determine the prevalence of untreated caries and caries experience among adults, with emphasis on individuals in the 34–45 and 65–74 years age ranges as recommended by the WHO;[5] to assess the relationship between untreated caries and socioeconomic status (SES); and to relate caries and its experience to modifiable behaviors among dental patients, at a teaching hospital in a metropolitan city in Northeast Nigeria.

Patients, Materials and Methods

Study design

This was a cross-sectional study among adult patients conducted over a six-month period in 2021. The study followed the criteria provided in the STROBE guidelines for conducting observational studies.[11]

Study population

The study included all consenting consecutive adult patients attending the oral diagnosis and restorative clinics of a tertiary dental center in Maiduguri, the largest urban metropolis in Northeastern Nigeria. A minimum sample size of 263 was calculated based on the proportion of individuals with caries in a previous study among clinic attenders,[4] at a confidence level of 95% (1-α) and 5% level of precision.

Data collection

Data collection was with an interviewer-administered questionnaire retrieving data on demographics and oral health behaviour/practices and by intraoral examination. The oral health practices surveyed included dental clinic attendance, flossing, use of fluoridated toothpaste, frequency of toothbrushing, and consumption of snacks in-between meals. SES indicators surveyed included level of education and occupation. Participants were classified into five socioeconomic groups using an adapted occupational classification[12] as: Class I (executive manager, company director, doctor, engineer, lawyers, university professor, traditional chief); Class II (civil servant, nurses, teacher, secretaries, clergymen, businessmen, pensioners); Class III (tailor, bricklayers, carpenters, typists, clerk, housewife); Class IV: (messengers, roadside trader, cleaners, night guards, farmers, unemployed); and Class V (undergraduate student, postgraduate student).

Intraoral examinations by two trained and precalibrated dentists (kappa 0.84–0.92) determined participants' caries status. The participants were examined for decayed/carious teeth (DT), teeth missing due to caries (MT) and filled teeth (FT) according to WHO guidelines.[13] Caries severity/experience was measured by the DMFT index.

Study criteria

Inclusion of participants into the study was dependent on informed consent to participate, as well as being an adult above the age of 18 years. Only those who declined to participate were excluded.

Data analysis

All statistical analyses were performed with SPSS software for Mackintosh (IBM Corp., Version 21.0. Armonk, NY, USA: IBM Corp.). Descriptive statistics included the frequencies and proportions of the participants' groups and evidence of dental caries. The Chi-squared test was used to determine the bivariate associations between the participants' variables and the presence of caries. The independent sample *t*-test and analysis of variance (ANOVA) were used to compare the mean outcomes (DT, FT, MT, and DMFT) by participants' variables, and *post hoc* test was carried out for statistically significant comparisons following the ANOVA analysis. Significant factors for the presence of caries in the Chi-square test were used in a multivariate logistic regression analysis to produce a model for predictive risk assessment. Level of statistical significance was set at $P < 0.05$.

Ethical considerations

Ethical approval (UMTH/REC/21/770) was obtained from the research and ethics committee of the hospital before the study commenced. All relevant principles of the Declaration of Helsinki (2013) were also followed.[14]

Results

Four hundred and fifty-one (451) which accounts for 93.0% of the 485 patients that attended the clinics during the study period participated in the study. The participants' ages ranged from 18 to 74 years with a mean (±standard deviation [SD]) age of 32.42 ± 10.69. Majority (n = 257, 57%) were males. While 92.7% had some form of formal education, 297 (65.9%) had tertiary education. Class II (193) and V (146) occupation categories made up 75.2% of the total, and 96.5% were urban dwellers. Participants who were less than 25 years old were the highest in proportion (n = 146, 32.4%), while the 35–44 and 65–74-year-old age groups accounted for 24.4% and 1.6% of the study population, respectively. Only 5.8% of participants visited the dental clinic regularly [Table 1].

Prevalence of untreated caries by participants' characteristics

Three hundred and sixty-eight (368) of the 451 participants had DT ≥1, giving an overall untreated caries prevalence of 81.6%. The difference in the proportion of participants diagnosed was related to age group (P = 0.002). Participants <25 years old accounted for 130 (35.3%) of the total diagnosed, while the 35–44 years old participants made up 23.9%. Diagnoses were lowest (0.8%) for the 65–74 years old. The proportion of diagnoses were also related to occupation ($P < 0.001$) and level of education (P = 0.007). There were more diagnoses

Table 1: Caries presence and prevalence according to participants' sociodemographic and socioeconomic status (*n*=451)

Variable	Present (DT ≥1), *n* (%)	Absent, *n* (%)	Total, *n* (%)	Prevalence, *n* (%)
Age group				
<25	130 (35.3)	16 (19.3)	146 (32.4)	89.0
25-34	111 (30.2)	24 (28.9)	135 (29.9)	82.2
35-44	88 (23.9)	22 (26.5)	110 (24.4)	80.0
45-54	27 (7.3)	12 (14.5)	39 (8.6)	69.2
55-64	9 (2.4)	5 (6.0)	14 (3.1)	64.3
65-74	3 (0.8)	4 (4.8)	7 (1.6)	42.9
P		0.002*		
Gender				
Male	202 (54.9)	55 (66.3)	257 (57.0)	78.6
Female	166 (45.1)	28 (33.7)	194 (43.0)	85.6
P		0.059		
Occupation				
Class I	16 (4.3)	18 (9.6)	24 (5.3)	66.7
Class II	144 (39.1)	49 (59)	193 (42.8)	74.6
Class III	29 (7.9)	1 (1.2)	30 (6.7)	96.7
Class IV	47 (12.8)	11 (13.3)	58 (12.9)	81.0
Class V	132 (35.9)	14 (16.9)	146 (32.4)	90.4
P		<0.001*		
Level of education				
No formal education	30 (8.2)	3 (3.6)	33 (7.3)	90.9
Below tertiary education	108 (29.3)	13 (15.7)	121 (26.8)	89.3
Tertiary education	230 (62.5)	67 (80.7)	297 (65.9)	77.4
P		0.007*		
Total	368 (81.6)	83 (18.4)	451 (100)	
Residence				
Urban	355 (96.5)	80 (96.4)	435 (96.5)	81.6
Rural	13 (3.5)	3 (3.6)	16 (3.5)	81.3
P		0.971		
Regular dental visits				
Yes	14 (3.8)	12 (14.5)	26 (5.8)	53.8
No	354 (96.2)	71 (85.5)	425 (94.2)	83.3
P		<0.001*		
Use of dental floss				
Yes	16 (4.3)	4 (4.8)	20 (4.4)	80.0
No	352 (95.7)	79 (95.2)	431 (95.6)	81.7
P		0.851		
Snacking in-between meals				
Yes	246 (66.8)	42 (50.6)	288 (63.9)	85.4
No	122 (33.2)	41 (49.4)	163 (36.1)	74.8
P		0.005*		
Use of fluoridated toothpaste				
Yes	305 (82.9)	77 (92.8)	382 (84.7)	79.8
No	28 (7.6)	3 (3.6)	31 (6.9)	90.3
Do not know	35 (9.5)	3 (3.6)	38 (8.4)	92.1
P		0.076		
Frequency of tooth brushing				
Once daily	188 (51.1)	31 (37.3)	219 (48.6)	85.8
Twice daily	180 (48.9)	52 (62.7)	232 (51.4)	77.6
P		0.024*		
Total	368 (81.6)	83 (18.4)	451 (100)	

*$P<0.05$ for Chi square comparisons of proportions. DT: Number of carious teeth

among males (54.9%). The larger proportion of participants with untreated caries ($n = 230$, 62.5%) were those with tertiary education. The prevalence was higher among nonregular clinic attenders ($P < 0.001$), those who snacked in-between

meals (P = 0.005), and those who brushed their teeth once daily (P = 0.024) versus twice daily [Table 1].

Prevalence of caries within participants groups

This prevalence was highest (89%) among participants <25 years, decreasing with increasing age range to 80% for the 35–44 years age group and least (42.9%) among the 65–74-year-old group. The prevalence was higher among females (86.5%), among participants in the class III occupation category (96.7%) and among those without formal education. Similarly, higher prevalence was recorded for nonregular clinic attenders (83.3%), nonfloss users (81.7%), participants with snacking habits (85.4%), and once daily toothbrushers (85.8%) [Table 1].

Assessment of decayed, missing and filled teeth index (DMFT) and its components

Table 2 presents the data on caries experience and the components with their variations according to participants characteristics. Untreated caries made up the major (n = 990 teeth, 65.6%) part of the raw DMFT (1,510). The mean (±SD) DMFT for the study participants was 3.35 ± 3.00. The mean DT was 2.20 ± 2.07, while the mean FT and MT were 0.49 ± 1.42, and 0.67 ± 1.36, respectively. The overall mean DT (2.20) contributed the highest proportion (65.7%) to the overall mean caries experience (3.35). The mean DMFT was highest (4.29 ± 5.44), but without statistical significance (P = 0.387) among the 65–74-year age group. It was 3.28 ± 2.75 among the 35–44 years old, and least for participants <25 years. The mean DMFT was also higher among females (3.65 ± 3.34), urban dwellers (3.44 ± 2.80), participants in the class III occupation category (3.83 ± 3.02), and those without formal education (4.42 ± 3.69). These differences in mean DMFT according to participants' SES and demographics were however not statistically significant.

Higher mean DMFT values were recorded for regular dental clinic attenders (3.69 ± 4.12), dental flossers (4.00 ± 3.87), fluoridated toothpaste users (3.37 ± 3.08), and participants who brush twice daily. These values were not statistically significant, except in participants who snacked between meals, P = 0.007. The DT scores were the major components of DMFT scores for all group scores except for the regular dental visitors whose FT was the major component (1.69 ± 3.33). These FT scores were higher (P < 0.001) than that for nonregular clinic attenders.

The DT component of the DMFT index was significantly higher for participants less than 25 years (P = 0.010), those in class III occupation (P < 0.001), and participants without formal education (P = 0.001). The mean FT was related to age (P = 0.007), occupation (P = 0.002), and level of education (P = 0.025). The mean MT values showed significant differences between age groups (P < 0.001) and occupation (P = 0.010). Following significant values with One-way ANOVA statistics, post hoc analysis showed that the significance in the DT scores was between participants less than 25 years and 35 – 44 years old (P = 0.044), between class II and III (P = 0.020) for occupation groups, and between participants with "no formal education" versus tertiary education (P = 0.002). The significant difference (P = 0.011) for FT was between class II and V occupation groups.

The differences in DT score regarding oral health practices were only significantly higher for nonregular dental visitors (P = 0.019). The mean FT was related to regular dental visits (P < 0.001) and frequency of tooth brushing (P = 0.027), while the mean MT was only significant for consumption of snacks between meals (P = 0.032) [Table 2]. Figures 1 and 2 present the contribution, in proportion, of untreated caries to the caries experience. It shows the relatively higher contribution among younger adults, males, rural dwellers, class V occupation, and participants with less than tertiary education.

Predictive risk for caries

A multiple regression model was generated for caries risk using the participants' variables that were significant for presence of caries. The variables (age, occupation, level of education, regular visit to the dentist, frequency of toothbrushing, and snacking in-between meals) all statistically significantly contributed to the fit of the model, F (7, 443) = 5.699, P = 0.000, R^2 = 0.083, R = 0.287, adjusted R^2 = 0.068. Only occupation (β = 0.131, P = 0.016) and level of education (β = −0.132, P = 0.006) were significantly related to and acted as predictors of the occurrence of dental caries [Table 3].

Discussion

The majority of Nigerian caries prevalence studies have been among children and adolescents between the ages of 6 and 15 years. There have been very few such studies among adults. This study would be one of the very few assessing dental caries among adults in the country and the first in the Northeastern region to assess caries experience (DMFT) and the contribution of untreated caries (DT) to this experience. The latter is believed to be more useful as a measure of disease burden.[15] DMFT as the measure of caries experience may present with higher scores among older adults due to cumulative history and is not as sensitive as DT in assessing disease burden. The contribution of cumulative experiences with age also applies to the MT and FT components. The DMFT index, however, remains the most widely used measure but could be more useful if trends in its individual components are assessed.[16] Population-specific needs and the effects of interventions are more clearly seen.[17]

The prevalence of untreated caries was high among the studied population. About four-fifth had at least one carious tooth. This ratio was higher than those reported from the southern part of the country.[7,8] Other studies have reported similar[18] and contrasting prevalence rates.[16,19,20] The prevalence in this study decreased steadily with increasing age like in a similar study.[2] This contrasted with reports from Georgia, where the highest prevalence was among 65–74-year-old individuals.[20] The high prevalence among the youngest adults

Table 2: Comparison of caries experience (decayed, missing and filled teeth) and its components by participants' variables (*n*=451)

Variable	Mean±SD			
	DT	FT	MT	DMFT
Age group				
<25	2.55±2.14	0.25±0.79	0.31±0.73	3.11±2.46
25-34	2.40±2.30	0.41±1.24	0.53±1.03	3.34±2.92
35-44	1.78±1.51	0.57±1.40	0.93±1.54	3.28±2.75
45-54	1.69±2.02	1.03±2.21	1.54±2.46	4.26±4.72
55-64	1.36±2.06	0.93±2.40	1.14±1.56	3.43±3.13
65-74	1.71±2.36	1.57±4.16	1.00±2.24	4.29±5.44
P	0.010**	0.007**	0.001**	0.387
Gender				
Male	2.09±2.113	0.46±1.20	0.57±1.01	3.12±2.70
Female	2.34±2.012	0.52±1.67	0.79±1.71	3.65±3.34
P	0.210	0.664	0.086	0.072
Occupation				
Class I	1.46±1.59	1.00±2.83	0.92±1.79	3.38±3.55
Class II	1.74±1.77	0.73±1.74	0.86±1.42	3.32±3.23
Class III	2.97±2.01	0.13±0.43	0.73±1.74	3.83±3.02
Class IV	2.34±2.30	0.33±1.00	0.71±1.64	3.38±3.16
Class V	2.71±2.26	0.22±0.59	0.34±0.84	3.27±2.51
P	<0.001**	0.002**	0.010**	0.923
Level of education				
No formal education	3.30±2.83	0.21±0.74	0.91±2.07	4.42±3.69
Below tertiary education	2.38±1.80	0.24±0.66	0.56±1.17	3.18±2.38
Tertiary education	2.00±2.04	0.62±1.67	0.68±1.34	3.00±3.12
P	0.001**	0.025**	0.405	0.095
Residence				
Urban	2.18±2.06	0.49±1.43	0.68±1.38	3.44±2.80
Rural	2.69±2.36	0.31±1.01	0.44±0.73	3.34±3.01
P	0.406	0.504	0.233	0.899
Regular dental visits				
Yes	1.31±1.87	1.69±3.33	0.69±1.12	3.69±4.12
No	2.25±2.07	0.41±1.18	0.67±1.37	3.33±2.92
P	0.019**	<0.001**	0.909	0.547
Use of dental floss				
Yes	2.10±1.97	0.9±2.36	1.00±1.62	4.00±3.87
No	2.20±2.08	0.47±1.36	0.65±1.35	3.32±2.95
P	0.828	0.182	0.356	0.445
Snacking in-between meals				
Yes	2.30±2.00	0.55±1.56	0.77±1.52	3.62±3.14
No	2.01±2.18	0.37±1.12	0.48±0.98	2.87±2.67
P	0.169	0.187	0.032**	0.007*
Use of fluoridated toothpaste				
Yes	2.17±2.07	0.53±1.52	0.67±1.37	3.37±3.08
No	2.74±2.52	0.19±0.40	0.23±0.56	3.16±2.63
Do not know	2.00±1.68	0.26±0.64	1.00±1.63	3.26±2.42
P	0.280	0.268	0.062	0.917
Frequency of tooth brushing				
Once daily	2.28±2.02	0.33±1.13	0.58±1.14	3.20±2.60
Twice daily	2.11±2.12	0.63±1.64	0.75±1.54	3.49±3.33
P	0.381	0.027**	0.185	0.297
Overall mean values	2.20±2.07	0.49±1.42	0.67±1.36	3.35±3.00

*$P<0.05$ for ANOVA comparisons of mean values, **$P<0.05$ for independent *t*-test comparisons of mean values. SD: Standard deviation, DT: Decayed teeth, FT: Filled teeth, MT: Missing teeth, DMFT: Decayed, missing and filled teeth

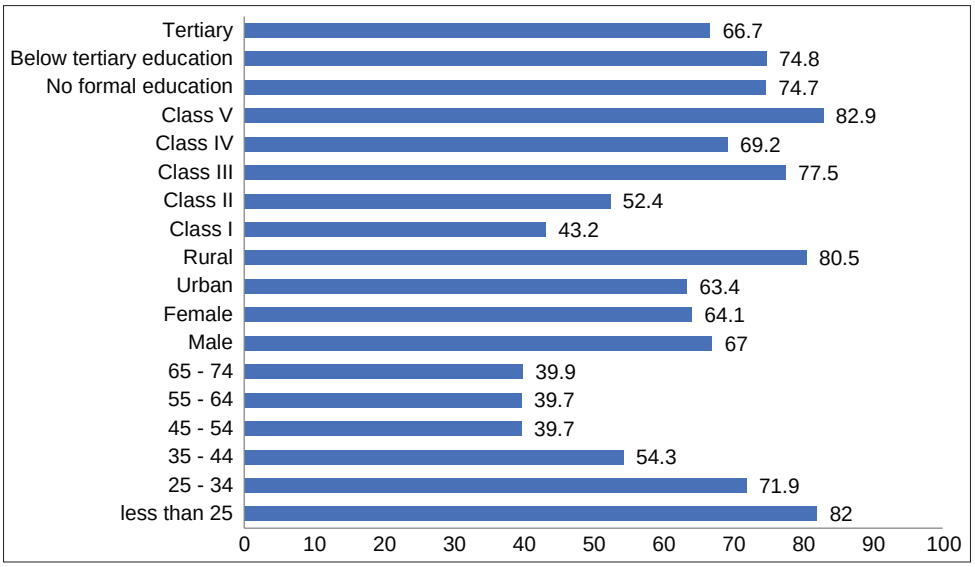

Figure 1: Untreated caries (DT) as a proportion (%) of the caries experience (DMFT) by the participants' sociodemographic

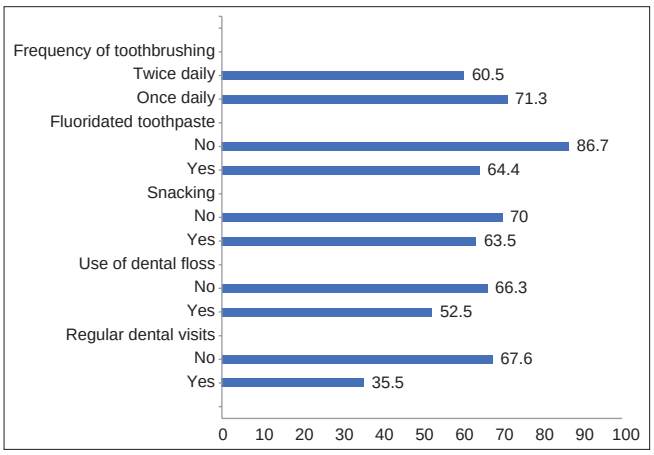

Figure 2: Untreated caries (DT) as a proportion (%) of the caries experience (DMFT) by the participants' oral health behaviour

in the present study was unexpected as they are expected to be covered, most probably being undergraduates, by the country's National Health Insurance Scheme for preventive and restorative procedures. The age group had the highest score for DT, which contributed the major part of their caries experience. High prevalence rates among young adults have been similarly reported.[2,18,21]

Our prevalence findings are also supported by an age-standardized systematic review of caries prevalence among adults which showed a shift in the peak prevalence from childhood to young adulthood. This trend was suggested to be due to WHO's emphasis on caries prevention programs being concentrated on children and adolescents, which stops after they leave school and become adults.[14] Surveys have shown a reduction in prevalence among adult populations where preventive programs were maintained into adulthood.[2,22,23]

The 35–44-year age group accounted for nearly a quarter of the untreated caries in our cohort, while the 65–74-year-old had the least numbers. Eighty percent (80%) and 43% within both age groups had untreated caries, respectively. These findings are similar,[2] higher,[22,23] and lower[17,20] than findings among same age groups in different populations. While there is limited Nigerian literature for comparison, a 25-year-old national survey reported a lower prevalence for the 35–44-year-old adults.[6] Our study may thus suggest an increase in the trend of untreated caries among this age group.

The mean DMFT of 3.35 in this study was lower than reports from other countries.[2,21] It was similar to another Nigerian study,[7] but contrasted with others.[8,9] The former Nigerian study was hospital based and the reported score of 3.57[7] may like ours be an overestimation of the population scores. DMFT has been shown to vary across populations within the same country.[23,24] These differences may be due to sociocultural and examiner variations.[22] The high level of untreated caries (DT) contributed the highest proportion (65.7%) to the overall caries experience, while FT accounted for only 14%. Kamberi *et al*. with their findings postulated that high DT and low FT components of the DMFT may be partly due to lack of utilization of dental services.[2] This is supported in our survey by the very low proportion (5.8%) of participants who visit the dental clinic regularly. Regardless of the low DMFT score, the high proportion of DT we observed may denote low dental awareness and poor utilization of dental services.

The DMFT was highest among the 65–74-year-old group, with the DT component contributing greatly to it. Access to dental services may have been restricted in this age group for lack of dental insurance following retirement,[25] which has been identified as a factor for high caries severity.[16] The high DT component may therefore have economic origins as treatment costs would be borne out-of-pocket. Although the DMFT

Table 3: Regression coefficients for predicting occurrence of dental caries

Variables	Unstandardized coefficients			Standardized coefficients (β)	*P*
	B	SE	95% CI for B (lower bound-upper bound)		
Constant	2.609	1.198	0.255-4.963		0.030
Age	−0.066	0.036	−0.137-0.005	−0.341	0.067
Occupation	0.192	0.080	0.036-0.348	0.131	0.016*
Level of education	−0.436	0.157	−0.744-−0.129	−0.132	0.006*
Regular dental visits	0.746	0.410	−0.059-1.552	0.084	0.069
Frequency of tooth brushing	0.022	0.193	−0.358-0.401	0.005	0.911
Snacking	−0.172	0.202	−0.568-0.224	−0.040	0.393

*P<0.05 in the predictive regression model, SE: Standard error, CI: Confidence interval

value for this age group was low, there has been reported lower values.[16] This study's finding is, however, lower than reports from several European and African populations.[2,22,26] The contribution of the FT component significantly increased with age, highest among the 65–74-year-old participants. This was also reported in several European populations.[23,27] Our findings, however, contrasted with the very low FT scores reported in other studies.[2,22,23]

The 35–44-year-old participants had a mean DMFT of 3.28, which is higher than the 2.5 reported from a previous National survey.[6] Both values are consistent with WHO's very low (<5.0) designation for this age group in Nigeria[27] and lower than reports from other countries.[2,22] Similar to the senior citizens, the DT component was greater than the other two components. There has been declining,[28] increasing,[24] and stable[22] DMFT trends among this age group in several populations. The decline among European adults was attributed to a reduction in the MT, but an increase was noticed for the FT component indicating improved treatment, but poor prevention.[28] This decline in caries experience, however, portends no real benefit to caries burden in the absence of a decrease in the DT component.

Although statistically insignificant, the DMFT and its components were higher among females in this study. Other studies have reported this difference to be significant.[7,24] The reason could be that females tend to consume more cariogenic food. They may also be more motivated toward regular dental visits and hence more caries diagnoses and restorations.[24]

SES is recognized as an important determinant of caries experience among populations.[17,24] The recorded effects of SES may, however, be influenced by the subjectivity involved in its classification.[29] The least prevalence rates were observed among participants with tertiary education and those in high-income professions (Class I). Majority of the participants in low-income professions would not have health insurance as they are in the informal sector, thus limiting their access to care,[25] with increased tendency to developing new carious lesions. They are more likely to have lower educational attainment, low oral health awareness, and poor attitude to preventive oral health services. In contrast, wealthier individuals and those with higher education tend to seek regular private preventive care and have fewer caries and lower DMFT.[30] This is seen in the significantly lower DT component and higher FT component of the caries experience for tertiary education and high-income professions in this study. This observation was supported by regression analysis, which showed level of education and occupation, to be the only significant predictors of caries occurrence. However, the caries experience (DMFT) was not affected by SES.

Nonregular visits to the dentist, snacking in-between meals, once daily teeth cleaning, and not using dental floss were associated with higher prevalence of untreated caries. Snacking in-between meals was, however, the only variable that significantly affected the caries experience. The association between snacking and caries experience was also reported among Chinese adults.[24] The latter, and our study supports the suggested importance and emphasis placed on the relationship between diet and caries.[31] Surprisingly, like other reports,[7,16] but contrary to another,[21] the caries experience was worse for subjects who use dental services regularly. This may result from past caries burden which increased clinic visits for treatment.[17,19] The significantly higher FT and lower DT component found in this group supports this assertion. Furthermore, as previously suggested, the high FT may be due to criteria for caries diagnosis and emphasis on restorative rather than preventive treatment.[32] Although we did not assess for this, it is possible that most participants who use dental floss are also regular dental clinic attenders, as they could have picked the habit from attending clinics. This would account for the lower DT but higher FT and MT compared to the nonflossers. The same argument can be put forward for the outcome of the DMFT and its components for those who use fluoridated toothpaste and brush twice daily.

There are limitations that should be noted in the present study. Due to the cross-sectional design, no cause-and-effect conclusions may be drawn regarding the associations between the prevalence and experience of dental caries and the participants' variables. The study was conducted among patients attending the dental clinics of the hospital, and the number of individuals in the two oldest age groups were minimal. The findings therefore may not reflect the occurrence of caries among the same adult age groups in the general population. This may thus limit the generalizability

of our findings to the general population. This study used the proposed criteria by the WHO for caries diagnosis. This may have produced an underestimation of the untreated caries and caries severity problem in this population as the diagnostic criteria excludes noncavitated and early carious lesions and those that could be detected with radiographs, especially interproximal caries. Despite these limitations, this study provides information that is representative enough for use as a basis for further studies on caries among adults in Nigeria.

Conclusions

The prevalence of untreated caries was high among all age groups. Younger age, low SES, irregular toothbrushing and dental visits, and snacking between meals were factors associated with higher caries prevalence. It was relatively high among the 35–44-year-old adults and lowest for the 65–74-year-old adults. SES was predictive of presence and number of untreated caries. Caries experience was low, but the DT component predominated, relatively higher among older adults but associated only with snacking between meals.

Our findings underscore the need for regular regional and national cross-sectional population-based studies on dental caries among adults, especially the WHO-prescribed age groups to provide data for determining the trend of the disease and planning of oral health programs. With the obvious rise in caries prevalence among adults, there is a need for the extension of oral health preventive programs targeted at these population groups. This will help address the inequality created by policy that favors only children and adolescents and adults in the formal sector and high-income professions.

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Conflicts of interest

There are no conflicts of interest.

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