Associations between Dental Caries, Oral Hygiene Status and Oral Health Practices of First Year Undergraduates in a Private University in Nigeria

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ABSTRACT

Objective: This study determined the associations between dental caries, oral hygiene status and oral health care practices among first-year undergraduates in a private university in Nigeria.

Methods: Secondary data was obtained from a cross-sectional study that recruited first-year undergraduates undertaking mandatory medical screening exercises. Data collection was through a self-administered questionnaire that assessed participants' sociodemographic characteristics and preventive oral health care measures. Oral examination for dental caries and oral hygiene status was done by qualified dentists. Data collected were analyzed using STATA version 13 for Mac Air. Pearson's Chisquare test was used to establish the associations between dental caries, oral hygiene, and preventive oral health care. Binary logistic regression was used to estimate the degree of association between the dependent and the independent variables.

Results: Of the 1,164 students that were screened, 123 (10.6%) had dental caries and 125 (10.7%) had poor oral hygiene. The frequency of tooth brushing in the morning after meal and at night after the meal was less than 6% across all age groups in both sexes. A higher poor oral hygiene prevalence was seen among participants who rarely use dental floss (36.0%) and those that had never used dental floss (41.6%). There was a significant difference in the consumption of refined sugar between females and males (P=0.01). Only 7.4% of the study participants visit the dental clinic once every six months in the multivariate model on dental caries, oral health care practices had no significant impact but age and students' last dental visit had a significant impact on oral hygiene status.

Conclusion: A low caries prevalence was recorded among the students. "Good oral hygiene" status recorded was low. Age and last dental visit were the strongest contributors. Students should be encouraged during their screening exercises to imbibe good oral hygiene measures and improve their oral health care practices including twice-yearly dental visits.

Keywords: First-year undergraduate, refined sugar consumption, oral health, toothbrushing, dental floss, frequency.

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INTRODUCTION

Oral health is the standard of health of oral and related tissues that enable an individual to eat, communicate, and socialize without active disease, discomfort or embarrassment thus contributing to a person's general well-being.[1] It is essential to an individual's general health and important in maintaining a healthy smile.

Oral diseases are one of the most common public health issues worldwide with significant socioeconomic, environmental, biological and behavioural impacts, yet they are frequently neglected in public health policies.[2] Dental caries and periodontal diseases are the most common oral diseases that affect a large percentage of the world population and can lead to prolonged physical discomfort, pain, infection and tooth loss.[3] The aetiologies of most oral diseases are behaviour related; adopting and maintaining preventive oral care practices can prevent these.[4-6] Preventive oral health care practices include the use of fluoridated toothpaste, regular and effective tooth brushing, use of dental floss for interdental cleaning and regular dental check-up. It also involves avoidance or reduction in the consumption of refined carbohydrates, especially in-between meals.[7-9]

The prevalence of caries in Nigeria is low,[10-12] but the prevalence of untreated dental caries is very high.[10] Contributory factors to the high prevalence of untreated dental caries include poor knowledge about preventive oral health care and poor health-seeking behaviour.[13] The level of education is associated with preventive oral health self-care and the utilization of dental services.[13,14] University students should have a vantage position to know, understand and practise oral health care.[15] This study determined the associations between sociodemographic variables (age and sex) and dental caries, oral hygiene status and oral health care practice among first-year undergraduates in a private university in Nigeria.

MATERIALS AND METHODS

This was a secondary data analysis of a dataset collected from 1,164 first-year undergraduates in 2016 to determine the association between dental caries and body mass index (BMI). The details of the primary study, including the sociodemographic data of the participants (age, sex, socioeconomic status, and family structure), had been reported by Oyedele et al.[16] Data variables extracted for analysis and sub-analysis were preventive oral health care measures and sociodemographic characteristics (age and sex) using a self-administered questionnaire, while the participants were clinically examined to know their oral hygiene status and dental caries experience.

The questions and responses in the questionnaire included frequency of tooth brushing: "once daily", "twice daily", "three times daily" and "after every meal". Time of brushing: "morning before meal", "morning after meal", "morning before meal and night after meal" and "morning after meal and night after meal". In-between meals: "once a day", "twice a day", "quite often" and "rarely". Actions taken after taking in-between refined carbohydrates meals: "brush my teeth immediately", "rinse my mouth with water", "rinse my mouth with mouthwash" and "do nothing". Interdental cleaning with dental floss: "yes" or "no". Frequency of using dental floss: "once daily", "after every meal", "rarely" and "never". Dental check-ups: "once in six months", "once a year", "rarely" and "never" were options available. Last dental check-up: "less than six months", "within 6 to 12 months", "between 1 to 2 years", and "never".

Oral hygiene assessment: Oral hygiene was determined using the simplified-oral hygiene index (OHI-S) by Greene and Vermillion.[17] The OHI-S has debris index and the calculus index. Each of the components was based on numerical determinations representing the amount of debris or calculus found on the preselected tooth surfaces. The calculus index simplified (CI-S) and debris index simplified (DI-S) values ranged from 0 to 3; the OHI-S value was the sum of CI-S and DI-S. The score ranged from 0 to 6. Oral hygiene index score of 0-1.2 was put as good oral hygiene; 1.3-3.0 for fair oral hygiene and 3.1-6.0 for poor oral hygiene.

Dental caries experience: Dental caries was assessed by dentists using the World Health Organization (WHO) criteria for oral health survey methods.[18] The examination for dental caries was conducted by using the light source from a dental unit, a dental mouth mirror and WHO probe. The student was seated on the dental chair. The teeth were examined wet after removing debris where present. Caries status was assessed using the Decayed, Missing, and Filled (DMFT) index. The caries experience was categorized into two: presence or absence of dental caries.

Standardization of oral health assessor

Before the commencement of the study, two dentists who carried out the intra-oral examination went through calibration exercises. Calibration for the diagnosis of dental caries and assessment of oral hygiene status was done. Inter-examiner and intra-

examiner variability scores were 0.85 and 0.90 respectively.

Data analysis

The data was processed and analyzed using STATA version 13 for Mac Air. All the discrete variables (age, sex, dental caries, oral hygiene status, oral health care practices) were analyzed using descriptive analysis. The associations between dental caries, oral hygiene and oral health care practices were determined at the bivariate and multivariate levels.

At the bivariate level, Pearson's Chi-square test was used to establish the associations between dental caries, oral hygiene, and preventive oral health care practices. Likewise, the associations between age, sex and preventive oral health care were carried out with Pearson's Chi-square test. At the multivariate level, two binary logistic regression models were performed to adjust for potential confounders and to estimate the degree of association (adjusted odds ratio) between the dependent and the independent variables.

The first model assessed the impact of age, sex, and several oral health practices (frequency of toothbrushing, time of brushing, in-between meals, action taken after in-between meals, frequency of using dental floss, frequency of dental visits and last dental visit) on the odds that a student would have poor oral hygiene status. The second model examined for independent risk indicators of dental caries among the students. Model fitness was checked using a Hosmer-Lemeshow goodness-of-fit test. Issues of multicollinearity between the independent variables were assessed by ensuring tolerance > 0.1 and variance inflation factor (VIF) < 10 for all predictor variables. Statistical significance was established at a *P*-value equal to or less than 0.05.

Ethical approval

Ethics approval for the primary study was obtained from the University's Health and Research Ethics Committee (BUHREC335/16). Informed consent was obtained from all participants before the study commenced.

RESULTS

A total of 1,164 respondents' data (721 female (61.9%) and 443 male (38.1%) participants) mean age was 18.13 ±4.99 years were evaluated for this study. Of these, 123 (10.6%) had dental caries and 686 (58.9%) had fair oral hygiene.

Table 1 shows that 671 (57.6%) participants brush their teeth once daily, and 313 (43.4%) females brush twice daily. Less than 1% of the participants brush thrice daily (0.5%) or after every meal (0.2%). There was no significant difference between the frequency of tooth brushing, age, and sex (P=0.98; P=0.23) respectively.

More than three-fifths, 279 (63%) of the male respondents and over half, 407 (56.4%) of the female participants across all age groups brush "morning before a meal". However, more than a third of females, 267 (36.5%) and about one-third of males, 130 (29.3%) participants brush "morning before a meal" and "night after meal" respectively. Over 30% of the participants, 393 (33.8%) across all age groups brush "morning before meal and night after meal".

The frequency of tooth brushing "morning after meal and night after meal" was less than 6% across all age groups and in both sexes. Although 50.2% of the study population across all age groups – both males and females – had used dental floss at one time or the other, only 6.4% of females and 48 (10.8%) male participants use it once daily. Across the age groups, 5.8% of 15 to 17-year-olds, 10.1% of 18 to 20-year-olds and 10.6% of 21 to 23-year-olds use dental floss daily. (Table 1).

Table 2 shows the association between preventive oral health measures, sex, and age of the study participants. A little more than a quarter of the respondents 335 (28.8%) consume refined sugars quite often. Within these, females consume refined sugars more than males (P=0.01) where 29.4% of females consume refined sugar more than twice daily as against 27.8% of males. Across the age groups, those 21 to 23-year-olds consume refined sugars more than twice daily (40.2%) compared with other age groups.

There was no statistically significant relationship (P=0.06); however, empirically, older participants consume refined sugar more frequently than the younger ones. Concerning action taken after refined sugar consumption, even though more than half of the participants act after consuming refined sugar, few participants brush (3.5%) or rinse with mouthwash (6.4%). More females (47.2%) do nothing after refined sugar consumption compared with males (26.6%). However, this was not statistically significant P=0.22. Regarding age, younger participants (≤20 years of age) do nothing after they consume refined sugar compared with older (above 20 years) participants (P=0.00).

The results of dental clinic visits showed that 7.4% of the study participants visit a dental clinic once every six months, 7.7% visit once a year, 36.3% rarely visit a dental clinic and 48.5% had never visited any dental clinic. There was no significant difference in dental

clinic visits in terms of sex and across all age groups (P=0.47; P=0.29 respectively). About 8.0% of the study participants visited a dental clinic in the last six months, 11.0% visited within the last 6 to 12 months and 28.9% visited within the last 1 to 2 years.

Table 3 shows the association between oral health care measures, dental caries, and oral hygiene. Respondents who brush once daily had poorer oral hygiene (56.0%) and higher dental caries experience (56.1%) compared with those who brush more than once daily. Regarding the time of brushing and dental caries, participants that brush in the "morning before meal" had a higher prevalence of dental caries (56.1%) while those who brush "morning after meal" and in the "morning after meal and at night after meal" (before bed) had a lower prevalence of dental caries (3.3% and 4.1% respectively).

There was no significant difference in dental caries experience between those who use dental floss and those who do not; however, there was higher caries prevalence among those who have never used dental floss (46.3%) compared with those who use it once daily, after every meal or rarely (10.7%, 8.9%, 34.1% respectively).

There was a higher prevalence of poor oral hygiene in respondents who brush once daily (56.0%) compared with those who brush more than once daily (P =0.04) and among those who brush "morning before meal" (60%) compared with those who brush "morning after meal" (1.6%), "morning before meal and night after meal" (34.4%) and "morning after meal and night after meal" (4.0%). Higher poor oral hygiene prevalence was seen among participants who rarely use dental floss (36.0%) and those who had never used dental floss (41.6%).

Table 4 shows that children who consume refined sugars twice daily and more often had higher caries experience (11.4% and 11.3% respectively) when compared with those who consume once daily (8.7%) and rarely (11.1%); however, this was not a statistically significant relationship. In addition, participants who took no action after consuming refined sugars had higher dental caries experience (12.3%) compared with others. A slightly higher dental caries experience was seen in respondents who rarely visit dental clinics (13.7%) and in those who had their last dental visit in the last 6 to12 months (17.2%).

The oral hygiene profile of the study participants showed that more participants had fair oral hygiene overall (58.9%) while 10.7% had poor oral hygiene. There were no significant differences in the oral hygiene status between meals, what the children do after taking between meals, frequency of dental visits and the last dental visit.

Table 5 shows the impact of age, sex, and several oral health care practices on the odds of poor oral hygiene status. The odds of having poor oral hygiene were 1.2 (95% CI: 0.81 – 1.9, p = 0.34) times as high in students aged 18 to 20, while the odds in older students (21 to 23 years) were 2.4 (95% CI: 1.4 – 4.3, p = 0.002) times as high. The odds of poor oral hygiene status were 3.7 (95% CI: 1.2 – 10.7, p = 0.02) times as high in students who last visited the dentist 6 to 12 months back. Also, students whose last visit to the dentist was one to two years back were 3.0 (95% CI: 1.04 – 8.7, p = 0.04) times more likely to have poor oral hygiene status. The odds ratio for those who have never visited the dentist was 2.5, with no statistical significance (95% CI: 0.77 – 8.3, p = 0.13). The odds of having poor oral hygiene were 1.4 times as high in males compared with females (95% CI: 0.96 – 2.1, p = 0.08).

Table 6 shows risk indicators of dental caries among first-year undergraduates Age and oral hygiene status were found to be statistically significant risk indicators of dental caries in the sample where the odds of dental caries in students aged 21 to 23 increased by 90% (odds ratio = 1.9; 95% CI: 1.1 – 3.3, p = 0.02). Also, the strongest predictor of dental caries in the sample was having poor oral hygiene, recording an odds ratio of 2.5 (95% CI: 1.3 – 4.8, p = 0.007). The odds of having dental caries were 1.8 times as high in students with fair oral hygiene (95% CI: 1.1– 3.0, p = 0.02).

Table 1. Association between oral health care measures, sex, and age of study participants.

	Sex, n (%)		**Age Group (Years), n (%)**			
Variables	Female	Male	15-17	18-20	21-23	Total
Frequency of tooth brushing						
Once daily	405 (56.2)	266 (60.0)	321 (57.8)	275 (57.7)	75 (56.8)	671 (57.6)
Twice daily	313 (43.4)	172 (38.8)	230 (41.4)	198 (41.5)	57 (43.2)	485 (41.7)

Thrice daily	2 (0.3)	4 (0.9)	3 (0.5)	3 (0.6)	-	6 (0.5)
After every meal	1 (0.1)	1 (0.2)	1 (0.2)	1(0.2)	-	2 (0.2)
***P* value**		*P*=0.23		*P*=0.98		
Time of brushing						
MBM	407 (56.4)	279 (63.0)	329 (59.3)	280 (58.7)	77 (58.3)	686 (58.9)
MAM	21 (2.9)	10 (2.3)	12 (2.2)	15 (3.1)	4 (3.0)	31 (2.7)
MBMNAM	263 (36.5)	130 (29.3)	193 (34.8)	155 (32.5)	45 (34.1)	393 (33.8)
MAMNAM	30 (4.2)	24 (5.4)	21 (3.7)	27 (5.7)	6 (4.5)	54 (4.6)
Dental Flossing						
Yes	372 (51.6)	212 (47.9)	291 (52.4)	233 (48.8)	60 (45.5)	584 (50.2)
No	349 (48.4)	231 (52.1)	264 (47.6)	244 (51.2)	72 (54.5)	580 (49.8)
Frequency of dental flossing						
AEM	45 (6.2)	30 (6.8)	33 (5.9)	32 (6.7)	10 (7.6)	75 (6.4)
Once daily	46 (6.4)	48 (10.8)	32 (5.8)	48 (10.1)	14 (10.6)	94 (8.1)
Rarely	288 (39.9)	141 (31.8)	233 (42.0)	160 (33.5)	36 (27.3)	429 (36.9)
Never	342 (47.3)	224 (50.6)	257 (46.3)	237 (49.7)	72 (54.5)	566 (48.6)
Total	721 (61.9)	443 (38.1)	555 (47.7)	477 (41.0)	132 (11.3)	1,164 (100.0)

NB. MBM: morning before meal; MAM: morning after meal; MBMNAM: morning before meal night after meal; MAMNAM: morning after meal night after meal; AEM: after every meal.

Table 2. Association between preventive oral health measures, sex, and age of study participants.

	Sex, n (%)		**Age group (Years), n (%)**			
Variables	**Female**	**Male**	**15-17**	**18-20**	**21-23**	**Total**
Frequency of sugar consumption						
Rarely	317 (44.0)	169 (38.1)	229 (41.3)	209 (43.8)	48 (36.4)	486 (41.8)
Once daily	166 (23.0)	133 (30.0)	163 (29.4)	111 (23.3)	25 (18.9)	299 (25.7)
Twice daily	26 (3.6)	18 (4.1)	18 (3.2)	20 (4.2)	6 (4.5)	44 (3.8)
Quite often	212 (29.4)	123 (27.8)	145 (26.1)	137 (28.7)	53 (40.2)	335 (28.8)
***P* value**		***P*=0.01***		*P*=0.06		
Action taken after sugar consumption						
Brush	26 (3.6)	15 (3.4)	9 (1.6)	27 (5.7)	5 (3.8)	41 (3.5)

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Rinse mouthwash	39 (5.4)	35 (7.9)	33 (5.9)	33 (6.9)	8 (6.1)	74 (6.4)
Rinse with water	316 (43.8)	205 (46.3)	246 (44.3)	203 (42.6)	72 (54.5)	521 (44.8)
Do nothing	340 (47.2)	188 (26.6)	267 (48.1)	214 (44.9)	47 (35.6)	528 (45.4)
***P* value**		*P*=0.22		**P=0.00***		
Frequency of dental visits						
Once in 6 months	52 (7.2)	34 (7.7)	44 (7.9)	37 (7.8)	5 (3.8)	86 (7.4)
Once a year	49 (6.8)	41 (9.3)	44 (7.9)	31 (6.5)	15 (11.4)	90 (7.7)
Rarely	266 (36.9)	157 (35.4)	193 (34.8)	177 (37.1)	53 (40.2)	423 (36.3)
Never	354 (49.1)	211 (47.6)	274 (49.4)	232 (48.6)	59 (44.7)	565 (48.5)
***P* value**		*P*=0.47		*P*=0.29		
***Last dental visit*.**						
< 6 months	63 (8.7)	30 (6.8)	44 (7.9)	36 (7.5)	13 (9.8)	93 (8.0)
6-12 months	62 (8.6)	66 (14.9)	58 (10.5)	57 (11.9)	13 (9.8)	128 (11.0)
1-2 years	216 (30.0)	120 (27.1)	171 (30.8)	123 (25.8)	42 (31.8)	336 (28.9)
Never	380 (52.7)	227 (51.2)	282 (50.8)	261 (54.7)	64 (48.6)	607 (52.1)
Total	**721 (61.9)**	**443 (38.1)**	**555 (47.7)**	**477 (41.0)**	**132 (11.3)**	**1,164 (100.0)**

Table 3. Bivariate analysis of associations between oral health measures, dental caries, and oral hygiene.

	Dental caries, n (%)		Oral hygiene, n (%)			
Variables	**Present**	**Absent**	**Good**	**Fair**	**Poor**	**Total**
Frequency of tooth brushing						
Once daily	69 (56.1)	602 (57.8)	226 (64.0)	375 (54.7)	70 (56.0)	671 (57.6)
Twice daily	53 (43.1)	432 (41.5)	123 (34.8)	308 (63.5)	54 (43.2)	485 (41.7)
Thrice daily	1 (0.8)	5 (0.5)	2 (0.6)	3 (50.0)	1 (0.8)	6 (0.5)
After every meal	-	2 (0.2)	2 (0.6)	-	-	2 (0.3)
***P* value**		*P*= 0.57		***P*= 0.04***		
Time of brushing						
MBM	69 (56.1)	617 (57.8)	224 (63.5)	387 (56.4)	75 (60.0)	686 (58.9)
MAM	4 (3.3)	27 (2.6)	7 (2.0)	22 (3.2)	2 (1.6)	31 (1.6)
MBMNAM	45 (36.6)	348 (33.4)	107 (30.3)	243 (35.4)	43 (34.4)	393 (33.8)

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MAMNAM	5 (4.1)	49 (4.7)	15 (4.2)	34 (5.0)	5 (4.0)	54 (4.6)
***P* value**		*P*= 0.85		*P*= 0.41		
Dental Flossing						
AEM	11 (8.9)	64 (6.1)	15 (4.2)	49 (7.1)	11 (8.8)	75 (6.4)
Once daily	13 (10.7)	81 (7.8)	26 (7.4)	51 (7.4)	17 (13.6)	94 (8.1)
Rarely	42 (34.1)	387 (37.2)	143 (40.5)	241 (35.1)	45 (36.0)	429 (36.9)
Never	57 (46.3)	509 (48.9)	169 (47.9)	345 (50.3)	52 (41.6)	566 (48.6)
***P* value**		*P*= 0.42		***P*= 0.04***		
Total	**123 (10.6)**	**1041 (89.4)**	**353 (30.3)**	**686 (58.9)**	**125 (10.7)**	**1164 (100.0)**

NB. MBM: morning before meal; MAM: morning after meal; MBMNAM: morning before meal night after meal; MAMNAM: morning after meal night after meal; AEM: after every meal

Table 4. Bivariate analysis of the association between preventive oral health measures, dental caries, and oral hygiene.

	Dental caries, n (%)		**Oral hygiene, n (%)**			
Variables	**Present**	**Absent**	**Good**	**Fair**	**Poor**	**Total**
Frequency of sugar consumption						
Rarely	54 (11.1)	432 (88.9)	163 (33.5)	275 (56.6)	48 (9.9)	486 (100.0)
Once daily	26 (8.7)	273 (91.3)	92 (30.8)	176 (58.9)	31 (10.3)	299 (100.0)
Twice daily	5 (11.4)	39 (88.6)	8 (18.2)	29 (65.9)	7 (15.9)	44 (100.0)
Quite often	38 (11.3)	297 (88.0)	90 (26.9)	206 (61.5)	39 (11.6)	335 (100.0)
***P* value**		*P*= 0.68		*P*= 0.23		
Action taken after sugar consumption						
Brush	4 (9.8)	37 (90.2)	7 (17.1)	30 (73.2)	4 (9.8)	41 (100.0)
Rinse Mouthwash	5 (6.8)	69 (93.2)	23 (31.1)	43 (58.1)	8 (10.8)	74 (100.0)
Rinse with water	49 (9.4)	472 (90.6)	171 (32.8)	306 (58.7)	44 (8.4)	521 (100.0)
Do nothing	65 (12.3)	463 (87.7)	152 (28.8)	307 (58.1)	69 (13.1)	528 (100.0)
***P* value**		*P*= 0.31		*P*= 0.10		
Frequency of dental visits						
Once in 6 months	11 (12.8)	75 (87.2)	37 (43.0)	39 (45.3)	10 (11.6)	86 (100.0)
Once yearly	10 (11.1)	80 (88.9)	28 (31.1)	52 (57.8)	10 (11.1)	90 (100.0)
Rarely	58 (13.7)	365 (86.3)	124 (29.3)	252 (59.6)	47 (11.1)	423 (100.0)

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Never	44 (7.8)	52 (92.2)	164 (29.0)	343 (60.7)	58 (10.3)	565 (100.0)
***P* value**		***P*= < 0.001***		*P*= 0.21		
Last dental visit						
< 6 months	9 (9.7)	84 (90.3)	39 (41.9)	49 (52.7)	5 (5.4)	93 (100.0)
6-12 months	22 (17.2)	106 (82.8)	33 (25.8)	76 (59.4)	19 (14.8)	128 (100.0)
1-2 years	41 (12.2)	295 (87.8)	111 (33.0)	187 (55.7)	38 (11.3)	336 (100.0)
Never	51 (8.4)	556 (91.6)	170 (28.0)	374 (61.6)	63 (10.4)	607 (100.0)
***P* value**		***P*= 0.02***		***P*= 0.04***		

Table 5. Multivariate analysis of age, sex, and oral health practices on oral hygiene status (OHI-S).

Independent variables		Poor OHI-S n (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	*P*-value
Sex	Female *(ref.)*	68 (9.4)	1.0	1.0	
	Male	57 (12.9)	1.4 (0.98 – 2.1)	1.4 (0.96 – 2.1)	0.08
Age	15 – 17 *(ref.)*	49 (8.8)	1.0	1.0	
	18 – 20	53 (11.1)	1.3 (0.86 – 1.9)	1.2 (0.81 – 1.9)	0.34
	21 – 23	23 (17.4)	2.2 (1.3 – 3.7)	2.4 (1.4 – 4.3)	0.002
Frequency of toothbrushing					
	> Once daily *(ref.)*	55 (11.2)	1.0	1.0	
	Once daily	70 (10.4)	0.93 (0.64 – 1.3)	0.69 (0.29 – 1.6)	0.40
Time of brushing					
	MAMNAM *(ref.)*	5 (9.3)	1.0	1.0	
	MBMNAM	43 (10.9)	1.2 (0.46 – 3.2)	1.3 (0.48 – 3.6)	0.60
	MBM	75 (10.9)	1.2 (0.47 – 3.1)	1.8 (0.51 – 6.1)	0.37
	MAM	2 (6.5)	0.68 (0.12 – 3.7)	0.86 (0.13 – 5.5)	0.87
Frequency of sugar consumption					
	Rarely *(ref.)*	31 (10.4)	1.0	1.0	
	Once daily	7 (15.9)	1.1 (0.66 – 1.7)	1.8 (0.72 – 4.5)	0.21
	Twice daily	39 (11.6)	1.7 (0.73 – 4.1)	1.2 (0.71 – 2.0)	0.51
	Quite often	48 (9.9)	1.2 (0.77 – 1.9)	0.99 (0.61 – 1.6)	0.97
Action taken after consumption					
	Brush *(ref.)*	4 (9.8)	1.0	1.0	
	Rinse with mouthwash	8 (10.8)	1.1 (0.32 – 3.9)	1.5 (0.41 – 5.9)	0.52
	Rinse with water	44 (8.4)	0.85 (0.29 – 2.5)	1.2 (0.40 – 4.0)	0.70
	Do nothing	69 (13.1)	1.4 (0.48 – 4.0)	2.4 (0.7 – 7.5)	0.14
Frequency of dental flossing					
	AEM *(ref.)*	17 (18.1)	1.0	1.0	
	Once daily	11 (14.7)	0.78 (0.34 – 1.8)	0.85 (0.36 – 2.0)	0.71
	Rarely	45 (10.5)	0.53 (0.29 – 0.98)	0.56 (0.29 – 1.1)	0.08
	Never	52 (9.2)	0.46 (0.25 – 0.83)	0.47 (0.25 – 0.89)	0.20
Frequency of dental visit					
	Once in 6 months *(ref.)*	10 (11.6)	1.0	1.0	
	Once a year	10 (11.1)	0.95 (0.37 – 2.4)	0.65 (0.24 – 1.8)	0.40
	Rarely	47 (11.1)	0.95 (0.46 -2.0)	0.65 (0.27 – 1.5)	0.33
	Never	58 (10.3)	0.87 (0.43 – 1.8)	0.70 (0.24 – 2.0)	0.50
Last dental visit					
	< 6 months *(ref.)*	5 (5.4)	1.0	1.0	

	6-12 months	19 (14.8)	3.1 (1.1 – 8.5)		3.7 (1.2 – 10.7)	0.02
	1-2 years	38 (11.3)	2.2 (0.86 – 5.9)	3.0 (1.04 – 8.7)	0.04	
	Never	63 (10.4)	2.0 (0.80 – 5.2)	2.5 (0.77 – 8.3)	0.13	

Table 6. Multivariate analysis of oral hygiene status and oral health practices on dental caries.

Independent variables		Dental caries n (%)	Crude odds ratio (95% CI)		Adjusted odds ratio (95% CI)		*P*-value
Sex	Female *(ref.)*	80 (11.1)	1.0		1.0		
	Male	43 (9.7)	0.86 (0.58 – 1.3)		0.85 (0.56 – 1.3)	0.44	
Age	15 – 17 *(ref.)*	52 (9.4)	1.0		1.0		
	18 – 20	47 (9.9)	1.1 (0.70 – 1.6)	0.97 (0.63 – 1.5)	0.90		
	21 – 23	24 (18.2)	2.2 (1.3 – 3.6)		1.9 (1.1 – 3.3)		0.02
OHI-S	Good *(ref.)*	23 (6.5)	1.0		1.0		
	Fair	79 (11.5)	1.9 (1.2 – 3.0)		1.8 (1.1 – 3.0)		0.02
	Poor	21 (16.8)	2.9 (1.5 – 5.4)		2.5 (1.3 – 4.8)		0.007
Frequency of toothbrushing							
	> Once daily *(ref.)*	54 (11.0)	1.0		1.0		
	Once daily	69 (10.3)	0.93 (0.64 – 1.4)		1.3 (0.48 – 3.7)	0.57	
Time of brushing							
	MAMNAM *(ref.)*	5 (9.3)	1.0		1.0		
	MBMNAM	45 (11.5)	1.3 (0.48 – 3.3)		1.3 (0.48 – 3.5)	0.61	
	MBM	69 (10.1)	1.1 (0.42 – 2.8)		0.92 (0.24 – 3.6)	0.90	
	MAM	4 (12.9)	1.5 (0.35 – 5.9)		1.2 (0.22 – 6.4)	0.83	
Frequency of sugar consumption							
	Rarely *(ref.)*	26 (8.7)	1.0		1.0		
	Once daily	5 (11.4)	1.3 (0.49 – 3.7)		1.3 (0.47 – 3.8)	0.58	
	Twice daily	38 (11.3)	1.3 (0.80 – 2.3)		1.3 (0.76 – 2.3)	0.33	
	Quite often	54 (11.1)	1.3 (0.80 – 2.1)		1.3 (0.79 – 2.2)	0.29	
Action taken after consumption							
	Brush *(ref.)*	4 (9.8)	1.0		1.0		
	Rinse with mouthwash	5 (6.8)	0.67 (0.17 – 2.6)	0.83 (0.20 – 3.4)	0.79		
	Rinse with water	49 (9.4)	0.96 (0.33 – 2.8)	1.2 (0.40 – 3.7)	0.73		
	Do nothing	65 (12.3)	1.3 (0.45 – 3.7)		1.9 (0.60 – 5.7)	0.28	
Frequency of dental flossing							
	AEM *(ref.)*	13 (13.8)	1.0		1.0		
	Once daily	11 (14.7)	1.1 (0.5 – 2.5)		1.04 (0.42 – 2.6)		0.94
	Rarely	42 (9.8)	0.68 (0.35 – 1.3)		0.70 (0.5 – 1.4)	0.33	
	Never	57 (10.1)	0.70 (0.37 – 1.3)		0.78 (0.40 – 1.6)	0.48	
Frequency of dental visit							
	Once in 6 months *(ref.)*	11 (12.8)	1.0		1.0		
	Once a year	10 (11.1)	0.85 (0.34 – 2.1)		0.67 (0.25 – 1.8)	0.43	
	Rarely	58 (13.7)	1.1 (0.54 – 2.2)		0.94 (0.41 – 3.1)	0.87	
	Never	44 (7.8)	0.58 (0.29 – 1.2)		0.54 (0.19 – 1.5)	0.24	
Last dental visit							
	< 6 months *(ref.)*	9 (9.7)	1.0		1.0		
	6-12 months	22 (17.2)	1.9 (0.85 – 4.4)		2.1 (0.86 – 4.9)	0.11	
	1-2 years	41 (12.2)	1.3 (0.61 – 2.8)		1.3 (0.53 – 3.0)	0.60	
	Never	51 (8.4)	0.86 (0.41 – 1.8)		1.2 (0.43 – 3.2)	0.76	

DISCUSSION

This study showed a low prevalence of dental caries in the study participants which is in agreement with Oziegbe and Esan's study where a low caries prevalence was reported.[10] This study also recorded low good oral hygiene status. The role of education cannot be ruled out for preventive oral health care and in the utilization of dental services. It is expected that the educational level of the university students should place them in a vantage position to know, understand and practise oral health care. This may have been impossible because education tends to be irrelevant unless oral health education is available and accessible to an educated population.[15]

In this study, it was observed that females consume more refined sugars in-between meals and take no action after consuming these refined sugars compared with males and participants in the older age groups who rinse their mouth with water. This may suggest that more male and older participants are more knowledgeable in terms of oral care when compared with the females and younger ones. There was significantly poorer oral hygiene in children that brush once daily compared with those who brush more than once daily.

The low dental caries prevalence reported in this study may be attributed to the education level and socioeconomic status of the study participants, being a study carried out in a private university where majority of the students have educated parents and are from middle to high socioeconomic class. This study showed that a good number of the study population brush their teeth at least once daily with fluoridated toothpaste; this is similar to findings by Ejemai et al.[19] This may be attributed to adequate knowledge that translates to practise among the participants. However, the percentage of study participants brushing twice daily in this study was higher than that reported in the study by Ejemai et al.[19] Al-Qahtani et al showed that adequate knowledge of oral health care results in practise, and this in turn reduces the prevalence of oral health diseases.[20]

The significant risk indicators of poor oral hygiene among the study participants were found to be age and last dental visit, suggesting a unique impact on the odds of poor oral hygiene status. In general, the odds of having poor oral hygiene status increased with increasing age group.. These results showed that having regular dental check-ups as part of oral health care practices is very important in maintaining good oral health – this had been reported in other studies.[21]

This study also showed that age and oral hygiene are the significant risk indicators of dental caries among the study participants. In older participants (21 to 23 years), the odds of having dental caries increased by 90% compared with the younger age group; this is in agreement with the study by Namal et al. who recorded higher dental caries prevalence among the older age group.[22] The odds of having dental caries were 2.5 times higher in participants with poor oral hygiene compared with those with good/fair oral hygiene. Poor oral hygiene has been reported in many studies as a risk factor for dental caries and this study confirms this.[23, 24]

One of the interesting findings in this study is that a good number of the study participants practise twice daily brushing, but the pattern of this twice daily brushing showed that more participants brush in the "morning before meal and night after meal" while few brush in the "morning after meal and night after meal". There was no consensus among oral healthcare providers as to the best pattern of tooth brushing; however, the British Dental Association advise that teeth should be brushed last thing at night and once during the day.[25]

Majority of the study participants had used dental floss before but not regularly. This was contrary to the findings by Al-Qahtani et al[20] where it was shown that majority of the study population had never used dental floss. The disparity in the study findings may be due to the difference in the study participants. This study was carried out among university undergraduates from mainly high socioeconomic and educated family backgrounds while the study by Al-Qahtani et al[20] was among intermediate school children from public and private schools. Socioeconomic status and educational level have shown to be a determinant of good oral health.[26-28] This finding was also contrary to the finding by Ejemai et al[19] which reported a low percentage of participants using dental floss. This may be due to unavailability or lack of awareness regarding dental floss, its use, and significance.

The combination of regular tooth brushing and the high percentage of dental floss utilization in this study group may be responsible for low prevalence of dental caries reported. Studies have shown that when different caries preventive approaches are employed, it reduces the prevalence of dental caries.[29, 30] Despite low caries prevalence in this study, a large percentage of the study participants rarely or had never visited any dental clinic for regular or routine dental checks. This may support the

suggestion that a combination of regular tooth brushing with fluoridated toothpaste and restrictions in the consumption of refined sugar in-between meals plays a significant role in dental caries prevention if there is no availability of dental health care facility.[31]

The higher caries prevalence in children that brush once daily compared with those who brush more than once daily reinforces the point that the single most effective dental caries preventive measure is the use of fluoridated toothpaste and interdental cleaning. This was supported by Featherstone[32] and Horst et al.[33] Similarly, poorer oral hygiene noted in participants who brush once daily compared with those who brush more than once daily affirms the significance of effective and frequent tooth brushing in the prevention of poor oral hygiene and overall oral health.[34, 35] There was no significant dental caries difference between children that consume refined sugar more regularly compared with those who consume it rarely. This again may be attributed to regular oral hygiene care. This study had some limitations that included lack of information about the use of other forms of fluoride apart from fluoridated toothpaste, failure to elicit information about brushing techniques and other materials used for tooth cleaning.

CONCLUSION

This study recorded a low prevalence of dental caries in the study participants and low "good oral hygiene" status. There was significant refined sugar consumption in-between meals in females compared with males and higher refined sugar consumption in older age groups. Female students in older age groups had higher consumption of refined sugar. Students who brush once daily had poorer oral hygiene when compared with those who brush more than once daily.

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