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Determination of the Prevalence and the Efficacy of Factors and Habits Associated with Toothbrushing among Outpatients in Lagos State University Teaching Hospital, Nigeria

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Abstract

Tooth brushing is the most common mechanical measure amongst the recommended contemporary oral hygiene procedures engaged in preventive dental therapy. This is to determine the prevalence of toothbrushing habits and their efficacy in the removal of tooth deposits and resultant clinical periodontal health of the participants. This study, involved 250 first-time patients the Family Medicine Department at the Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos. Data collection was conducted using a self-administered questionnaire to obtain the sociodemographic data and the participants' toothbrushing habits. The efficacy of toothbrushing was assessed by evaluating the Oral hygiene index (OHI) and the periodontal status of the participants. Appropriate descriptive statistics were carried out. Pearson's chi-square analysis was done to determine the bivariate relationship of the covariates and their efficacy, while regression analysis was done to assess the multivariate relationship. Statistical significance was determined at $p \leq 0.05$. The mean age of the participants was 40.1 ± 18.4 years; the 20-29-year-olds had the highest percentage with good oral hygiene, 20(30.3%). Those who brush their teeth more than twice daily had the highest percentage with good oral hygiene,4(66.7%) (p=0.002) and healthy periodontium, 4(66.7%) (p=0.03). Toothbrushing duration was significantly associated with the oral hygiene status (p=0.001). Those who brush their teeth >120 seconds had the highest percentage with good oral hygiene, 44(65.7%), and healthy periodontium, 39(58.2%) (p=0.001). Toothbrushing duration was the only habit that was independently associated with the oral hygiene status (p=0.001). Toothbrushing duration, age groups and male sex were independently associated with the periodontal status ($p<0.05$). Oral health education and counselling have to be holistic, as many of the factors and habits operate jointly in the provision of healthy oral hygiene and periodontal health. Brushing for up to 3 minutes will be more beneficial for the overall health of individuals.

Keywords: Toothbrushing habits, Frequency of brushing, Duration of brushing.

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INTRODUCTION

Tooth brushing involves the use of a brush, which may be of various designs, to brush the teeth and massage the gingival tissue in an effort to enhance a clean oral cavity and sustain good oral health [1,2]. Tooth brushing is the most common amongst the recommended contemporary oral hygiene procedures engaged in preventive dental therapy [1,2,3]. It is a mechanical measure of substantial plaque and debris removal from the tooth and oral structures. It also maintains acceptable dental appearance, prevents bad mouth odour, and enhances the individual's psychosocial well-being [1,2,3]. Dental plaque, currently defined as a microbial biofilm which forms so quickly after brushing the teeth, is often found on the tooth surface and dental appliances and is a major causative factor of periodontal inflammatory conditions such as gingivitis and periodontitis [4]. Plaque stagnation at the gingival margin often results in inflammation of the adjacent gingiva. As the microbial biofilm matures, the severity of the inflammation increases [3,4]. At this stage,

removing the biofilm leads to complete restitution of gingival health within a few days. But if the biofilm persists, the gingivitis spreads deeper and involves the other components of the periodontium, such as the alveolar bone and the periodontal ligament, resulting in periodontitis and increasing the risk of gingival recession, tooth mobility, and tooth loss [3,4]. Full resolution of the periodontal health at this stage is difficult to achieve. Globally, the prevalence of severe periodontitis is 11.2%, making it the 6th most prevalent chronic disease [4]. It negatively affects an individual's oral health, quality of life, self-confidence, nutrition, speech and general wellness [4]. Periodontitis has independently been associated with several systemic diseases. Dental plaque is also an aetiological factor of dental caries. Notably, mechanical plaque control in the form of tooth brushing is essential for the prevention of periodontal diseases and dental caries [3,4,5].

Effective plaque removal depends not only on the type of toothbrush but also on the proper tooth brushing technique. Various manual toothbrushing techniques have been described [5]. These usually differ in the brush's movement pattern, which may be horizontal, vertical, or circular [2]. Different toothbrushing techniques have been defined and designed over the last two to three decades; these include the Bass, Stillman's, Chartes, Scrub, Fones', and Roll methods [2,5]. It has to be emphasised that neither is superior to the other. Hence, it is agreed that a determined, meticulous and correct application of a brushing method is more essential than emphasis on a particular method [2,5]. The American Dental Association recommends a soft-bristle toothbrush for routine tooth brushing and that a toothbrush should be changed at least once every three months [2].

The duration of toothbrushing is an important variable in the efficacy of debris and plaque removal [6]. Baruah and coworkers reported that for effective removal of plaque, about 30-45 seconds must be spent brushing each quadrant, making up 120 to 180 seconds (2-3 minutes) for the whole mouth. The usual duration of brushing varies between 30 and 60 seconds [7].

In another study carried out by Beals and others on 173 adults in the United States [8]. They inferred that the mean duration of brushing was 46 seconds. Another study reported that plaque removal in subjects who brush their teeth for more than 3 minutes was 55% more compared to those who brush their teeth just for 30 seconds, while those who brush for 2 minutes had only 26% plaque removal [6,9]. It is worth noting that even after brushing for 3 min, plaque and debris removal was not 100% [6]. Vakil et al reported that there is a monotonic decrease in plaque index as the duration of brushing increases [10].

Although factors such as individual socio-economic status, lifestyle, and dental visits influence toothbrushing habits, it is recommended that patients brush their teeth at least twice or more per day [2]. In the morning after breakfast, and at night, before sleep. Studies have shown that this rule is very effective in oral hygiene maintenance in many patients that has followed it [2,7,11]. A Saudi Arabian study involving 44,779 individuals showed that almost 60% of the population brushed their teeth less than once daily [3].

Toothbrushing is also an important channel for the application of fluorides, which are anti-caries agents in the dentifrices [12]. Dentifrice can come in the form of powder, paste, or other forms used for cleansing the teeth as adjuncts to toothbrushing [2,9,12]. They enhance aesthetics and the freshness of breath and help prevent oral diseases. It may also be a means of delivery of antimicrobial agents, given the general acceptance and wide use of these compounds [12]. Toothbrushes are also classified by texture, usually as hard, medium, soft, or extra soft. Texture labelling had been without regulation [5]. Manufacturers label their products based on their own defined format; one manufacturer's labelling as soft may be stiffer than another's labelling as medium [5]. Soft and extra-soft bristles are mild on teeth, unlike thicker bristles. A hard-bristled brush results in more tooth wear than softer bristles [13]. A previous study involving 360 university students in Port Harcourt, Nigeria, showed that all the participants used toothpaste with their toothbrushes [14]. It also revealed that 90%, 8.1% and 1.9% of them brush once, twice and more than twice daily, respectively. The study also showed that 52.2%, 30%, and 17.5% uses medium textured, hard textured and soft textured toothbrushes, respectively [14].

There is a dearth of literature on the prevalence and effectiveness of toothbrush habits, such as the texture of brushes, the techniques, duration, and frequency of tooth brushing among Nigerians. Determination of these will further enhance preventive oral health education and promotion in Nigeria. It will provide a knowledge base for holistic counselling of the people about their toothbrushing habits, without leaving anything out. This study, therefore, is to determine the prevalence of toothbrushing habits and their efficacy in the removal of tooth deposits and their relationship with the clinical periodontal health status of the participants.

METHODOLOGY

The study location was the Family Medicine Department at the Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, Nigeria. LASUTH is a tertiary referral hospital and a training institution for medical, dental and other allied medical specialties in Lagos, Nigeria. The Department receives an average of 600 patients weekly.

This was a cross-sectional study, involving 250 first-time patients, of whom 111 were males, while 139 were females. Sample selection was by convenient

sampling. The inclusion criteria included consenting participants aged 15 years and above who use toothbrushes alone to clean their teeth. Participants who were diabetic, pregnant, on steroids or who had scaling and polishing or who had any major periodontal procedure within the previous 3 months were excluded from the study.

Data collection was conducted using a self-administered questionnaire, which comprised both open-ended and closed-ended questions. This was used to obtain the biodata such as age, sex, and educational status. It was also used to collect data on the participants' toothbrushing habits, such as their technique, frequency of brushing, duration of brushing, texture of the toothbrush and the dentifrice being used. The efficacy of toothbrushing was assessed primarily by evaluating the Oral hygiene index (this determined the ability to remove debris, plaque and calculus from the tooth surface). The Oral hygiene was graded as good when the index was between 0.1 and 1.2, fair when it was between 1.3 and 3.0, and poor when it was between 3.1 and 6.0. It was secondarily assessed by scoring the periodontal status of the participants using the CPITN index. 0 assessed as healthy periodontium, 1 and 2 were assessed as gingivitis, 3 was assessed as mild to moderate periodontitis and 4 as severe periodontitis. Written informed consent was obtained from the subjects before they participated in the study. Ethical approval for this research was obtained from the Health Research and Ethics Committee of Lagos State University Teaching Hospital (LASUTH).

Data analysis was carried out using SPSS version 24. For continuous descriptive variables, such as age and OH, the mean, minimum, maximum, and measures of variability were determined. While simple frequency and percentages were determined for categorical variables such as age groups, sex, educational status, toothbrushing technique, frequency of brushing, duration of brushing, texture of the toothbrush and the dentifrice being used. Pearson's chi-square analysis was carried out to determine the bivariate relationship of the covariates and the variables assessing their efficacy of toothbrushing such as OH status and the periodontal status. Multivariate analysis was done using ordinal logistic regression to assess the relationship of the covariates, and the and OH status and periodontal status of the participants. Statistical significance was determined at $p \leq 0.05$.

RESULTS

The mean age of the participants was 40.1 ± 18.4 years, with ages ranging from 14 to 78 years. The 20-29 and 30-39 age groups have the highest population in this study, with 66 (26.4%) and 59 (23.6%) participants, respectively. Those older than 60 years were 42(16.8%), while the least were the 10-19 years old 16(6.4%) (Figure 1). The male-to-female ratio was 1:1.3 (Table 1). Most of the participants in this study attained up to the tertiary level of education, 192(76.8%), followed by those with secondary level, 52(20.8%). Those with no formal education were the least 4(1.6%) (Table 1). The mean OHI was1.79± 0.81.

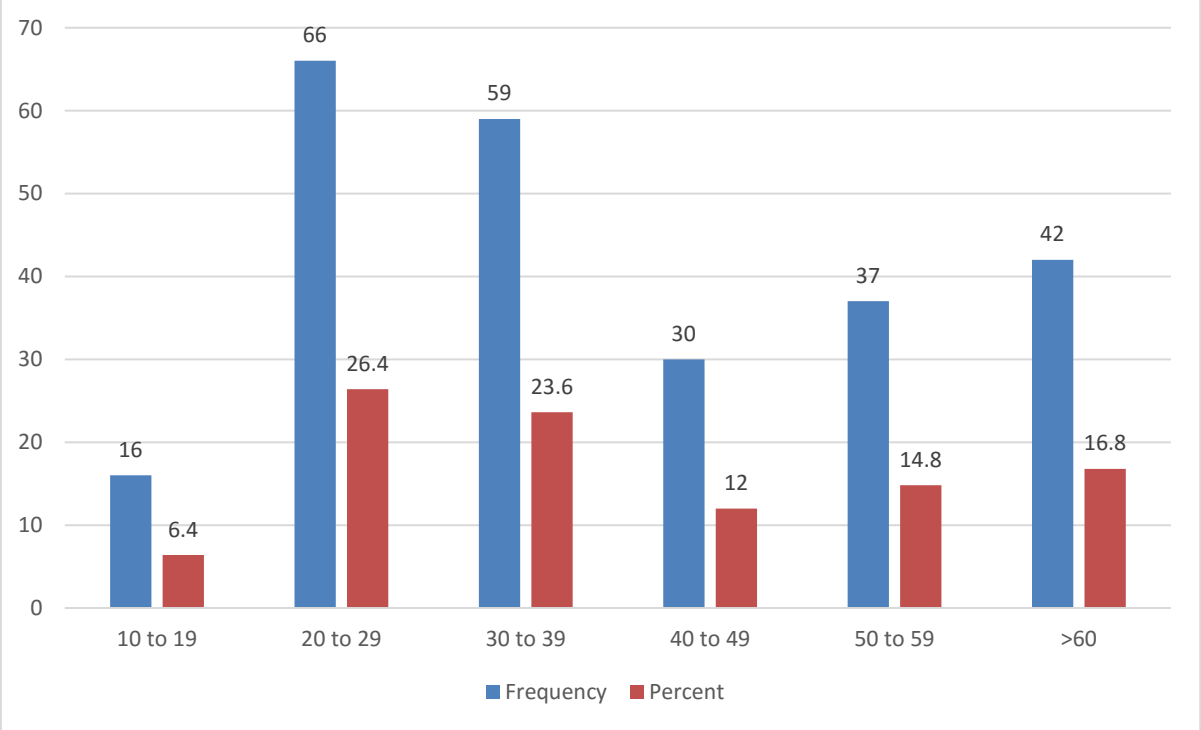

Figure 1: Description of the Subjects by Age Groups

Most of the participants brush their teeth once daily, 130(52%), followed by those who brush twice daily, 114(46.5%). Only 6(1.4%) of the participants brush their teeth more than twice daily. Table 1 further shows that the medium-textured toothbrush is the most preferred among participants, with 159 (63.6%). Of them, 57 (22.8%) use soft-textured brushes, while 34 (13.6%) opt for hard-textured toothbrushes. Nearly an equal number of participants use horizontal and vertical brushing techniques, with 97 (38.8%) and 96 (38%) respectively, while only 10 (4%) use the vibratory technique. Most participants brush their teeth between 60 and 120 seconds, whereas those who brush for less than 60 seconds and those who brush for more than 120 seconds are almost equal at 69 (27.6%) and 67 (26.8%), respectively. Fluoridated toothpaste was the most common dentifrice used by the participants in this study, 190(76%), followed by toothpowder 26(10.4%), and herbal toothpaste 24(9.6%), 893.2%) uses charcoal. The mean OHI was1.79± 0.81. Most of the participants have fair oral hygiene, 193(77.2%), followed by those with good, 47(18.8%), and poor, 10(4%). A healthy periodontal status was found in most of the participants, 92(36.8%), mild to moderate gingivitis in 75(30%), and severe periodontitis was found in the least number, 26(10.4%) of the participants.

Table 1: Description of the Variables

Variable		Number	Percentage
Sex	Male	111	44.4
	Female	139	55.6
Educational level	None	4	1.6
	Primary	2	8
	Secondary	52	20.8
	Tertiary	192	76.8
Frequency of brushing	Once	130	52
	Twice	114	45.6
	More than twice	6	2.4
Texture of the brush	Soft	57	22.8
	Medium	159	63.6
	Hard	34	13.6
Technique of brushing	Horizontal	97	38.8
	Vertical	95	38
	Circular	48	19.2
	Vibratory	10	4
Duration of brushing	<60 secs	69	27.6
	60-120 secs	114	45.6
	>120 secs	67	26.8
Dentifrice used	Fluoridated toothpaste	190	76
	Tooth powder	26	10.4
	Charcoal	8	3.2
	Herbal toothpaste	24	9.6
	Others	2	0.8
Oral hygiene grade	Good (0.1-1.2)	47	18.8
	Fair (1.3-3.0)	193	77.2
	Poor (3.1-6.0)	10	4
Periodontal status	Healthy (CPI-0)	92	36.8
	Gingivitis (CPI-1&2)	57	22.8
	Mild-moderate periodontitis (CPI-3)	75	30
	Severe periodontitis (CPI-4)	26	10.4

While assessing the efficacy of toothbrushing with oral hygiene status using Pearson's chi-square (Table 2), the age groups were significantly associated with oral hygiene grade (p=0.009). The 20-29-year-olds have the highest percentage with good oral hygiene, 20(30.3%), followed by the 10-19-year-olds 4(25%). The 30-39-year-olds have the highest percentage of fair oral hygiene, 49(83.1%), followed by the 50-59-year-olds, 30(81.1%), and those older than 60 years, 34(81%). Poor oral hygiene was highest among the 40-49-year-olds, followed by the 10-19-year-olds, 2(12.5%). The sex of the participants was also significantly associated with their oral hygiene status (p=0.009); the males had the highest percentage of fair oral hygiene, 92(82.9%), while the females had higher percentages in the good 28(20.2%) and poor 10(7.2%) oral hygiene grades. Participants with a tertiary level of education had the highest percentage with good oral hygiene, 39(20.3%) and poor oral hygiene, 8(4.2%), while those with primary and secondary levels of education had the highest

percentage with fair oral hygiene, 4(100%) and 2(100%), respectively. This association was, however, not statistically significant p>0.05.

Table 2: Chi-Square Analysis of the Determinants and Characteristics of Toothbrushing and the Oral Hygiene Status of the Participants

Variables		Oral hygiene status			
		Good n(%)	Fair n(%)	Poor n(%)	P-value
Age	10-19 years (16)	4(25)	10(62.5%)	2(12.5)	0.009*
	20-29 years (66)	20(30.3)	46(69.7)	0	
	30-39 years (59)	6(10.2)	49(83.1)	4(6.8)	
	40-49 years (30)	4(13.3)	22(73.3)	4(13.3)	
	50-59 years (37)	7(18.9)	30(81.1)	0	
	>60 years (42)	6(14.3)	34(81)	2(4.8)	
Sex	Male (111)	19(17.1)	92(82.9)	0	0.009*
	Female (139)	28(20.2)	101(72.7)	10(7.2)	
Educational level	None (4)	0	4(100)	0	0.787
	Primary (2)	0	2(100)	0	
	Secondary (52)	8(15.4)	42(80.8)	2(3.9)	
	Tertiary (192)	39(20.3)	145(75.5)	8(4.2)	
Frequency of toothbrushing	Once (130)	20(15.4)	106(81.5)	4(3.1)	0.002*
	Twice (114)	27(23.7)	83(72.8)	4(3.5)	
	More than twice (6)	4(66.7)	2(33.3)	0	
Toothbrush texture	Soft (57)	15(26.3)	42(73.7)	0	0.146
	Medium (159)	24(15.1)	127(79.9)	8(5.1)	
	Hard (34)	8(23.5)	24(70.6)	2(5.9)	
Technique of brushing	Horizontal (97)	20(20.6)	75(77.3)	2(2.1)	0.190
	Vertical (95)	15(15.8)	72(75.8)	8(8.4)	
	Circular (48)	10(20.8)	38(79.2)	0	
	Vibratory (10)	2(20)	8(80)	0	
Duration of brushing	<60 secs (69)	0	59(85.5)	10(14.5)	0.001*
	60-120 secs (114)	3(2.6)	111(97.4)	0	
	>120 secs (67)	44(65.7)	23(34.3	0	
Dentifrice used	Fluoridated toothpaste (190)	41(21.6)	143(75.3)	6(3.2)	0.035*
	Tooth powder (26)	4(15.4)	22(84.6)	0	
	Charcoal (8)	0	8(100)	0	
	Herbal toothpaste (24)	2(8.3)	18(75)	4(16.7)	
	Others (2)	0	2(100)	0	

Frequency of toothbrushing was significantly associated with participants' oral hygiene status (p=0.002). Those who brush their teeth more than twice daily had the highest percentage with good oral hygiene, 4(66.7%), followed by those who brush twice and once daily, 27(23.7%) and 20(15.3%). Participants who brush their teeth once daily had the highest percentage with fair oral hygiene, 106(81.5%). None of those who brush their teeth more than twice daily had poor oral hygiene, while it was found in 4(3.5%) and 4(3.1%) of those who brush twice and once daily, respectively. The texture of the toothbrush used by the participants was not significantly associated with their oral hygiene status (p>0.05). Good oral hygiene was highest among those using a soft-textured toothbrush, fair oral hygiene was highest among those using a medium-textured toothbrush, and poor oral hygiene was highest among those using a hard-textured toothbrush.

The technique of toothbrushing was not statistically significant with the oral hygiene status of the participants in this study (p>0.05). Those who brush their teeth using the circular motion had the highest percentage with good 10(20.8%) oral hygiene status, those using the vibratory technique had the highest percentage with fair 38(79.2%) oral hygiene status, and poor oral hygiene status was highest among those using the vertical toothbrushing technique. The duration of toothbrushing was significantly associated with the oral hygiene status of the participants. (p=0.001). Those who brush their teeth for more than 120 seconds had the highest percentage with good oral hygiene status, 44(65.7%), followed by those who brush their teeth between 60 and 120 seconds, 3(2.6%). There was none who brushed for less than 60 seconds who had good oral hygiene. Those who brushed their teeth between 60 and 120 seconds also had the highest percentage of fair oral hygiene status 111(97.4%). Poor oral hygiene status was

found only among those who brushed their teeth for less than 60 seconds. The dentifrice used by the participants was significantly associated with their oral hygiene status (p=0.035). Those using fluoridated toothpaste had the highest percentage with good oral hygiene status, 41(21.6%), those using charcoal had the highest with fair oral hygiene status, 8(100%), while the highest percentage with poor oral hygiene status was among those using herbal toothpastes 4(16.7%).

Assessment of the clinical efficacy of toothbrushing parameters using the periodontal health status of the participants (Table 3) showed that the age groups had no significant association with the periodontal status in this study (p>0.05). The 40-49 years age group has the highest percentage of healthy periodontium, 15(50%), and it also had the highest percentage of participants with gingivitis, 12(32.4%). Mild to moderate gingivitis was highest among those older than 60 years 15(35.7%), while severe periodontitis was highest among the 10-19-year-olds. Sex was significantly associated with the periodontal status of the participants (p=0.049) higher percentage of males had healthy periodontium, 48(43.2%), and mild to moderate periodontitis, 36(32.4%), compared to the females. While a higher percentage of the females had gingivitis, 37(26.6%) and severe periodontitis, 19(13.7%). Educational level attained by the participants was not significantly associated with their periodontal health status (p>0.05). Those with tertiary level of education had the higher percentage of them with healthy periodontium 75(39.1%), gingivitis was highest among those with no formal education 1(25%), mild to moderate periodontitis was highest among those with primary level of education and those with no formal education, 1(50%) and 2(50%) respectively, while severe periodontitis was also commonest among those with primary level of education 1(50%).

The frequency of toothbrushing among participants was significantly associated with their periodontal status (p=0.03). Participants who brush their teeth more than twice daily had the highest percentage with healthy periodontium 4(66.7%), followed by those who brush twice 52(45.6%), and the lowest percentage was among those who brush their teeth only once daily 39(23.1%). Percentage of the participants with gingivitis, mild to moderate periodontitis and severe periodontitis were highest among those who brush their teeth only once daily, with 33(25.4%), 41(31.5%) and 17(13.1%) respectively, while the lowest percentage was among those who brush more than twice daily, with 1(16.7%) and 0, respectively. The texture of the toothbrush used by the participants was significantly associated with their periodontal status (p=0.01). The highest percentage of those with healthy gingiva was found among those who use a medium-textured toothbrush, 63(39.6%). Gingivitis was highest among those who use soft textured 23(40.4%), while mild to moderate periodontitis and severe periodontitis were highest among those who use medium-textured 49(30.8%) and hard-textured 5(14.7%) toothbrushes, respectively.

The association between the participants' technique of toothbrushing and their periodontal status was not significant (p>0.05). Participants who use vibratory motion in brushing had the highest percentage of healthy periodontium 5(50%), but none had severe periodontitis. Gingivitis was highest among those who use circular motion 15(31.3%), while those who use the horizontal technique of toothbrushing had the highest percentage of mild to moderate periodontitis. Severe periodontitis was highest among those who use the vertical technique of toothbrushing, 17(17.9%). Duration of toothbrushing was very significantly associated with the periodontal status of the participants (p=0.001). Those who brush their teeth for more than 120 seconds had a higher percentage of them with healthy periodontium, 39(58.2%), followed by those who brush their teeth for 60-120 seconds, 48(42.1%), and the lowest were those who brush their teeth for less than 60 seconds, 5(7.3%). While gingivitis was highest among those who brush their teeth for more than 120 seconds 20(29.9%), they had none with severe periodontitis. Those who brushed for less than 60 seconds had a higher percentage of them with mild to moderate periodontitis, 33(47.8%) and severe periodontitis, 21(30.4%). The dentifrice used by the participants also had a significant association with their periodontal status (p=0.007). Participants using some unspecified dentifrices had a higher percentage of them with healthy periodontium and mild to moderate periodontitis, with 1(50%), respectively. Participants using charcoal had more of them with gingivitis, 4(50%), while those using herbal toothpaste had the highest percentage of the participants with severe periodontitis, 7(29%).

Table 3: Chi-Square Analysis of the Determinants and Characteristics of Toothbrushing and the Periodontal Status of the Participants

Variables		**Periodontal status**				
		Healthy n (%)	**Gingivitis n (%)**	**Mild to moderate periodontitis n (%)**	**Severe periodontitis n (%)**	**P value**
Age	10-19 years (16)	8(50)	2(12.5)	3(18.8)	3(18.8)	0.192
	20-29 years (66)	20(30.3)	20(30.3)	21(31.8)	5(7.6)	
	30-39 years (59)	16(27.1)	16(27.1)	19(32.2)	8(13.6)	

	40-49 years (30)	15(50)	3(10)	9(30)	3(10)	
	50-59 years (37)	13(35.1)	12(32.4)	8(21.6)	4(10.8)	
	>60 years (42)	20(47.6)	4(9.5)	15(35.7)	3(7.1)	
Sex	Male (111)	48(43.2)	20(18)	36(32.4)	7(6.3)	**0.049***
	Female (139)	44(31.7)	37(26.6)	39(28.1)	19(13.7)	
Educational level	None (4)	1(25)	1(25)	2(50)	0	0.567
	Primary (2)	0	0	1(50)	1(50)	
	Secondary (52)	16(30.8)	11(21.2)	19(36.5)	6(11.5)	
	Tertiary (192)	75(39.1)	45(23.4)	53(27.6)	19(9.9)	
Frequency of toothbrushing	Once (130)	39(23.1)	33(25.4)	41(31.5)	17(13.1)	**0.030***
	Twice (114)	52(45.6)	24(21.1)	31(23.9)	7(5.4)	
	More than twice (6)	4(66.7)	1(16.7)	1(16.7)	0	
Toothbrush texture	Soft (57)	17(29.8)	23(40.4)	16(28.1)	1(1.8)	**0.010***
	Medium (159)	63(39.6)	27(17)	49(30.8)	20(12.6)	
	Hard (34)	12(35.3)	7(20.6)	10(29.4)	5(14.7)	
Technique of brushing	Horizontal (97)	38(39.2)	20(20.6)	33(34.1)	6(6.2)	0.183
	Vertical (95)	31(32.6)	20(21.1)	27(28.4)	17(17.9)	
	Circular (48)	18(37.5)	15(31.3)	12(25)	3(6.3)	
	Vibratory (10)	5(50)	2(20)	3(30)	0	
Duration of brushing	<60 secs (69)	5(7.3)	10(14.5)	33(47.8)	21(30.4)	**0.001***
	60-120 secs (114)	48(42.1)	27(23.7)	34(29.8)	5(4.4)	
	>120 secs (67)	39(58.2)	20(29.9)	8(11.9)	0	
Dentifrice used	Fluoridated toothpaste (190)	78(41.1)	42(22.1)	55(29)	15(7.9)	**0.007***
	Tooth powder (26)	7(26.9)	5(19.2)	10(34.5)	4(15.4)	
	Charcoal (8)	2(25)	4(50)	2(25)	0	
	Herbal toothpaste (24)	4(16.7)	6(25)	7(29.2)	7(29.2)	
	Others (2)	1(50)	0	1(50)	0	

Table 4: Multivariate Analysis of Toothbrushing Characteristics and Oral Hygiene Index of the Participants

Variables		**Estimate**	**Std. Error**	**Wald**	**df**	**Sig.**	**95% Confidence Interval**	
							Lower Bound	**Upper Bound**
Location	Frequency of toothbrushing	-.029	.421	.005	1	.944	-.855	.796
	Toothbrush texture	-.354	.391	.822	1	.365	-1.120	.411
	Technique of toothbrushing	-.007	.253	.001	1	.979	-.503	.489
	Duration of toothbrushing	-4.634	.673	47.438	1	.000*	-5.953	-3.315
	Dentifrice used	.205	.201	1.041	1	.307	-.189	.599
	[agegroup=1.00]	-.937	7.598	.015	1	.902	-15.828	13.954
	[agegroup=2.00]	-2.545	7.544	.114	1	.736	-17.331	12.241
	[agegroup=3.00]	-1.214	7.547	.026	1	.872	-16.005	13.577
	[agegroup=4.00]	-.591	7.551	.006	1	.938	-15.391	14.210
	[agegroup=5.00]	-2.339	7.558	.096	1	.757	-17.152	12.475
	[agegroup=6.00]	-2.124	7.561	.079	1	.779	-16.944	12.696
	[agegroup=7.00]	0[a]	.	.	0	.	.	.
	[sex=1.00]	-.455	.473	.922	1	.337	-1.382	.473
	[sex=2.00]	0[a]	.	.	0	.	.	.
	[highesteducation=1.00]	.944	1.586	.354	1	.552	-2.165	4.053
	[highesteducation=2.00]	-3.875	7.570	.262	1	.609	-18.712	10.963
	[highesteducation=3.00]	-.105	.743	.020	1	.888	-1.562	1.352
	[highest education=4.00]	0[a]	.	.	0	.	.	.

Table 5: Multivariate Analysis of Toothbrushing Characteristics and Periodontal Health of the Participants

Variable		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Frequency of toothbrushing	-.301	.228	1.742	1	.187	-.748	.146
	Toothbrush texture	-.035	.221	.025	1	.875	-.467	.398
	Toothbrushing technique	-.126	.149	.710	1	.399	-.418	.167
	Duration of toothbrushing	-1.492	.197	57.485	1	.000*	-1.878	-1.107
	Dentifrice used	.204	.122	2.787	1	.095	-.036	.444
	[age group=1.00]	16.565	.649	651.180	1	.000*	15.292	17.837
	[age group=2.00]	17.532	.417	1770.052	1	.000*	16.716	18.349
	[age group=3.00]	17.235	.423	1660.345	1	.000*	16.406	18.064
	[age group=4.00]	16.738	.509	1082.281	1	.000*	15.741	17.735
	[age group=5.00]	17.020	.472	1298.841	1	.000*	16.095	17.946
	[age group=6.00]	16.961	.000	.	1	.	16.961	16.961
	[sex=1.00]	-.633	.266	5.659	1	.017*	-1.155	-.111
	[sex=2.00]	0[a]	.	.	0	.	.	.
	[highest education=1.00]	-.031	1.025	.001	1	.976	-2.040	1.977
	[highest education=2.00]	1.107	1.429	.601	1	.438	-1.693	3.907
	[highest education=3.00]	.561	.337	2.761	1	.097	-.101	1.222
	[highest education=4.00]	0[a]	.	.	0	.	.	.

Multivariate analysis showed that the duration of toothbrushing is the only factor that is independently associated with the oral hygiene condition of the participants (p=0.001) when other confounders were controlled for (Table 4), with a point estimate of -4.6 showing an inverse relationship between the oral hygiene status and duration of toothbrushing. Table 5 is also a multivariate analysis which revealed that duration of toothbrushing (p=0.001), the participants' age groups (p=0.001) and male sex (p=0.017) were independently associated with the periodontal status of the participants. The duration of toothbrushing has a point estimate of -1.49 which also reveals an inverse relationship with the participants periodontal status (Table 5).

DISCUSSION

Almost 80% of participants had fair oral hygiene, higher than the proportion reported by Osadolor et al. in a previous Nigerian study, where 45.5% had fair oral hygiene, and the majority (49.4%) had poor oral hygiene. This may arise because their study was carried out in a rural population [15]. About 37% of the participants presented with a healthy periodontal status, while severe periodontitis was found in the bout 10% of the participants. This is at variance with a study by Ojo et al in Lagos, Nigeria, that reported 28.2% with healthy periodontium and 31.8% with severe periodontitis [16]. Most of the participants were in the middle-aged group, aged 20 to 39 years. The age groups were significantly associated with oral hygiene status, similar to another study [17], but they had no significant association with the periodontal status in this study. Though the 40-49-year-old age group has the highest percentage of healthy periodontium, severe periodontitis was highest among the 10-19-year-olds.

Sex was a very significant factor associated with the oral hygiene status of the participants. This is similar to previous studies [18,19]. Males had the highest percentage of participants with fair oral hygiene, while females had the highest percentage with good oral hygiene. Many other studies have postulated that females commonly present with better oral hygiene than males [19,20,]. A higher percentage of males had healthy periodontium and mild to moderate periodontitis, compared to the females. While a higher percentage of the females had gingivitis and severe periodontitis, this disagrees with other studies that reported better oral health in females. About three-quarters of the participants attained up to the tertiary level of education, while 1.6% had no formal education. Participants with a tertiary level of education had the highest percentage with good oral hygiene; this association was, however, not statistically significant. This was also true of the periodontal health status. This supports that the higher socioeconomic class is associated with better oral hygiene and health

Most participants brush their teeth once daily (46.5%); 1.4% brush more than twice daily. This differs from a review by Ayamolowo et al that reported twice daily tooth brushing up to 66.9% in a Nigerian study [21]. The frequency of toothbrushing was significantly associated with participants' oral hygiene status. Those who brush their teeth more than twice daily had 66.7% with good oral hygiene, those who brush twice and once daily had 23.7% and 15.3%. About 82% of those who brush their teeth once daily had the highest percentage with fair oral hygiene, 106(81.5%). None of those who brush their teeth more than twice daily had poor oral hygiene. This emphasised that the more the frequency of toothbrushing, the more the efficacy of plaque removal from the tooth surfaces. The frequency of toothbrushing

among participants was significantly associated with their periodontal status. Participants who brush their teeth more than twice daily had the highest, with 66.7% of them having healthy periodontium. The percentage of the participants with gingivitis, mild to moderate periodontitis and severe periodontitis was highest among those who brush their teeth only once daily, while the lowest percentage was among those who brush more than twice daily. This showed that healthier periodontal health is dependent on the number of times toothbrushing is carried out daily [11]. Dental professionals advise toothbrushing twice daily for a healthy mouth.

About 63.6% of the participants preferred the medium-textured toothbrush; a previous study in Nigeria reported 90% [14], but the texture of the toothbrushes used by the participants was not significantly associated with their oral hygiene status $p>0.05$. This suggests that other factors play a more significant role in adequately removing plaque and calculus from the teeth. On the other hand, it was significantly associated with their periodontal status. Healthy gingiva was highest among those who use a medium-textured toothbrush, similar to another study in Nigeria [14] and Sudan [22]. Dental professionals advise patients to use soft toothbrushes for effective plaque control without injuring the periodontal tissues [11,23]. The technique of toothbrushing was not statistically significant in relation to the participants' oral hygiene and periodontal status in this study. This further underscores that dexterity is more efficacious than any particular technique of toothbrushing [23].

Most participants brush their teeth between 1 and 2 minutes, whereas about an equal proportion brush for less than 1 minute and more than 2 minutes. A US study reported a mean duration of toothbrushing of 46 seconds [8]. The duration of toothbrushing was significantly associated with the oral hygiene status of the participants. About 65.7% who brush their teeth for more than 2 minutes had the highest percentage with good oral hygiene status, followed by those who brush their teeth between 1 and 2 minutes. Poor oral hygiene status was found only among those who brushed their teeth for less than 1 minute. Duration of toothbrushing was also very significantly associated with the periodontal status of the participants. Those who brush their teeth for more than 2 minutes had a higher percentage of healthy periodontium, followed by those who brush their teeth for 1 to 2 minutes. Gingivitis was highest among those who brush their teeth for more than 2 minutes; there was none with severe periodontitis. Those who brushed for less than 1 minute had a higher percentage of them with mild to moderate periodontitis and severe periodontitis. This shows that the longer the duration of brushing, the more efficacious is the ability for plaque removal and periodontal health maintenance. Creeth and colleagues reported that brushing for 3 minutes is more than twice as effective in plaque control as brushing for 2 minutes [9].

Fluoridated toothpaste (76%) was the most common dentifrice used by the participants in this study. followed by toothpowder, and herbal toothpaste, 2% uses charcoal. The dentifrice used by the participants was significantly associated with their oral hygiene status. Those using fluoridated toothpaste had the highest percentage with good oral hygiene status, while the highest percentage with poor oral hygiene status was among those using herbal toothpastes. This is discordant with some studies that reported positive effects of herbal toothpaste on the periodontal health [24]. The dentifrice used by the participants also had a significant association with their periodontal status. Participants using charcoal had more of them with gingivitis, while those using herbal toothpaste had the highest percentage of participants with severe periodontitis. A randomized clinical trial showed that fluoride-containing toothpastes had positive effects on the periodontal tissues [25]. The duration of toothbrushing was the only factor that was independently associated with the oral hygiene condition of the participants, with a point estimate of -4.6 showing an inverse relationship between the oral hygiene status and duration of toothbrushing. The duration of toothbrushing, the participants' age groups and male sex were independently associated with the periodontal status of the participants. The duration of toothbrushing has a point estimate of -1.49, which also reveals an inverse relationship with the participants' periodontal status. A study reported a profound effect of fluoride-containing toothpaste on gingivitis.

CONCLUSION

Duration of toothbrushing was the only common factor independently associated with both the efficacy in maintaining healthy oral hygiene status and clinical periodontal status. In this study, as in some others, brushing beyond 2 minutes provides better oral hygiene and healthier periodontal status. Age groups and the male sex were also independent factors associated with periodontal status. Sociodemographic factors such as age and sex, and toothbrushing habits like brushing frequency and the use of dentifrice were also associated with oral hygiene status, albeit these were jointly associated with other covariates. Sex, frequency of brushing, and the texture of the toothbrush and dentifrice used were jointly effective in maintaining periodontal health. This shows that oral health education and counselling have to be holistic, as many of the factors and habits operate jointly in the provision of healthy oral hygiene status and periodontal health. It should be directed at both young and old and all genders. It is also very important to emphasise the duration of toothbrushing when advising anyone about their oral health. It is clear that brushing for less than 1-minute results in poorer outcomes in the oral hygiene status and also the clinical periodontal status. Educating the population to brush for up to 3 minutes will do a lot of good for the general population and the overall health of individuals. Counselling on brushing twice or more daily using a soft-textured toothbrush with fluoride is very

important in the quest for achieving the much-desired goal of a healthier mouth and healthier body. Any technique that is easy to use, efficient and non-injurious should be the one recommended for people's use. It should also be policy-driven by authorities that adverts and health jingles should emphasise all the habits associated with toothbrushing

Conflict of Interest: Nil.

REFERENCES

1. Akhimie, E. E., Oginni, F. O., Oginni, A. O. (2013). A study of tooth brushing pattern and its effects on dental tissues in Obafemi Awolowo University students. Nig Dent J, 21(2).
2. Iba, B., & Adamu, V. E. (2021). Toothbrushing: An effective oral hygiene measure. Orapuh Journal, 2(2), e811.
3. Abogazalah, N. N., Alzubaidi, A., Alqahtani, S. A., Alamoudi, N. A., & Martinez-Mier, E. A. (2025). Toothbrushing Frequency in Saudi Arabia: Associations with Sociodemographics, Oral Health Access, General Health, and Diet. *International Journal of Environmental Research and Public Health, 22*(5), 764. https://doi.org/10.3390/ijerph22050764.
4. Deinzer, R., Weik, U., Eidenhardt, Z., Leufkens, D., Sa¨lzer, S. (2024) Manual toothbrushing techniques for plaque removal and the prevention of gingivitis—A systematic review with network meta-analysis. PLoS ONE, 19(7), e0306302. https://doi.org/10.1371/journal.pone.0306302
5. Kaveri, B., Vijay, K. T., Pravek, K., Queentaj, B., Rahul Vinaychandra, T., & Heena, D. (2017). A Review on Toothbrushes and Tooth Brushing Methods. International Journal of Pharmaceutical Science Invention, 6(5), 29-38. ISSN (Online): 2319 – 6718, ISSN (Print): 2319 – 670X
6. Pavani, B., Anu, V., Cinthiya, G.S., Deepika, V., Ayesha, M. S., & Reddy A. A. (2023). The effect of toothbrushing duration on plaque removal: A randomized crossover trial. J Datta Meghe Inst Med Sci Univ,18:369-71.
7. Baruah, K. et al. (2017) 'A Review on Toothbrushes and ToothBrushing Methods', 6(5),29–38.
8. Beals, D., Ngo, T., Feng, Y., Cook, D., Grau, D. G., & Weber, D. A. (2000). Development and laboratory evaluation of a new tooth brush with a novel brush head design. Am J Dent, 13, 5A-13A.
9. Creeth, J. E., Gallagher, A., Sowinski, J., Bowman, J., Barrett, K., Lowe, S. et al. (2009) The effect of brushing time and dentifrice on dental plaque removal in vivo. J Dent Hyg, 83(3),111-6. Epub. PMID: 19723429.
10. Nishu, V., Surinder, S., Pooja, G., & Abhishek, Singh. (2019). Evaluation of Relationship between Time of Manual Tooth-Brushing and Plaque Removal. Saudi J Oral Dent Res, 4(5): 302-304. ISSN 2518-1300 (Print) |ISSN 2518-1297 (Online)
11. Attin, T., & Hornecker, E. (2005). Tooth brushing and oral health: how frequently and when should tooth brushing be performed? Oral Health Prev Dent, 3(3), 135-40. PMID: 16355646.
12. Becky, D. E. (2008). Prevention Strategies for Periodontal Diseases, Prevention in Clinical Oral Health Care, Mosby, Chapter 16, 213-229, ISBN 9780323036955, https://doi.org/10.1016/B978-0-323-03695-5.50020-3.
13. Kumar, S., Gopalkrishna, P., Syed, A. K., & Sathiyabalan, A. (2025). The Impact of Toothbrushing on Oral Health, Gingival Recession, and Tooth Wear—A Narrative Review. *Healthcare, 13*(10), 1138. https://doi.org/10.3390/healthcare13101138
14. Bashiru, B. O., & Anthony, I. N. (2014). Oral self-care practices among university students in Port Harcourt, Rivers State. Niger Med J. 55(6), 486-9. doi: 10.4103/0300-1652.144703. PMID: 25538367; PMCID: PMC4262845.
15. Osadolor, A. J., Ekariama, A., Oyibo, A. I., & Osadolor, O. O. (2021). Assessment of the oral health knowledge, attitudes and practices among dental patients presenting at a secondary healthcare facility in Southern Nigeria. Yen Med J, 3(2):103–115.
16. Kehinde, O. O. et al. (2023). Prevalence of periodontitis and oral hygiene practices among diabetic and non-diabetic patients in a tertiary hospital in Lagos: a cross-sectional study. Pan African Medical Journal, 45(131). 10.11604/pamj.2023.45.131.37904
17. Kondkari, S. A., Deshpande, S. M., Nimmagadda, H., Shetty, U., Agarwal, S., Mistry L. et al. (2024). Oral hygiene with age: A comprehensive study. Bioinformation, 20(11):1555-1559. doi: 10.6026/9732063002001555. PMID: 40162462; PMCID: PMC11953561.
18. Holtkamp, A., & Naumann, M. (2025). Is Sex More than A Risk Factor? Sex as Biological Variable and Oral Health. J Community Med Public Health, 9: 521. https://doi.org/10.29011/2577-2228.100521
19. Lipsky, M. S., Su, S., Crespo, C. J., & Hung, M. (2021). Men and Oral Health: A Review of Sex and Gender Differences. American Journal of Men's Health, 15(3), 155798832110163. https://doi.org/10.1177/15579883211016361
20. Liechti, L., Regitz-Zagrosek, V., Gebert, P. et al. (2025). Sex and gender differences in periodontal disease: a cross-sectional study in Switzerland. BMC Oral Health 25, 1324. https://doi.org/10.1186/s12903-025-06719-3
21. Ayamolowo, L. B., Esan, A. O., Ibitoye, O. S. et al. (2024). Oral health behavior of pregnant women in Nigeria: a scoping review. BMC Oral Health 24, 971 (2024). https://doi.org/10.1186/s12903-024-04728-2
22. Wafaa, A. K. (2017). Comparing Effectiveness of Soft, Medium and Hard Bristle Tooth Brushes on Oral Hygiene International Journal of Science and

Research (IJSR), 6(7). doi: 10.21275/ART20175619 ISSN (Online): 2319-7064

23. Mehta, D. S., Kishore, A., Sharma, K. S., Agrawal, N., Singh M, et al. (2022) Toothbrushes and Tooth Brushing Methods: A Periodontal Review. J Clin Stud Med Case Rep, 9, 0129.
24. Anwar, M. A., Sayed, G. A, Hal, D. M., Hafeez, M. S., Shatat, A. S., & Salman, A., et al. (2025). Herbal remedies for oral and dental health: a comprehensive review of their multifaceted mechanisms including antimicrobial, anti-inflammatory, and antioxidant pathways. Inflammopharmacology, 33(3), 1085-1160. doi: 10.1007/s10787-024-01631-8. Epub. PMID: 39907951; PMCID: PMC11914039.
25. Geisinger, M. L., Geurs, N. C., Novy, B. et al. (2023). A randomized double-blind clinical trial evaluating comparative plaque and gingival health associated with commercially available stannous fluoride-containing dentifrices as compared to a sodium fluoride control dentifrice. J Periodontol, 94:1112–1121.https://doi.org/10.1002/JPER.22-0675