

Determination of the Effect of Dental Anxiety on Pain Perception during Scaling in a Group of Nigerian Patients

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DOI: [10.36348/sjmps.2021.v07i07.009](https://doi.org/10.36348/sjmps.2021.v07i07.009)

| Received: 18.06.2021 | Accepted: 25.07.2021 | Published: 30.07.2021

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Abstract

Background: This study aimed to determine patients' perception of pain during scaling and determine its relationship with their level of dental anxiety. It also evaluated differences in the pain perception between genders and its relationship with age. **Materials and Methods:** The cross-sectional study was conducted at the Periodontology Unit of the Lagos State University Teaching Hospital. Supra-gingival scaling was performed on the six mandibular anterior teeth of 94 consenting participants. The Visual Analog Scale (VAS) was used to record the patient's pain level while the Modified Dental Anxiety Scale (MDAS) was used to measure dental anxiety. Gender and age differences between Anxiety Scores and VAS was compared using Student's unpaired t-test and ANOVA respectively. *P*-value < 0.05 was considered to be statistically significant. **Results:** Females had higher overall Mean MDAS scores (12.87±4.79). Similarly, respondents aged 18-40years had higher Mean MDAS scores (12.00±4.65) than those aged 41-85years even though the association was not significant. Females also had higher OHI-S scores (2.57±1.22), Bleeding Index scores (48.57±39.38), Gingival Index (1.57±0.58) scores than males though the association was not significant. In addition, females had higher mean VAS scores (31.44±23.44) than males and those aged 18-40 years had higher mean VAS scores (31.44±23.44) than those aged 41-85 years though the association was not significant. **Conclusion:** Scaling and polishing was associated with higher pain and anxiety levels among females and younger respondents while patients with worse oral hygiene and gingival inflammation experienced more discomfort during the procedure. The proportion of patients that experienced severe pain increased with increased dental anxiety but the association was not significant. It is recommended that patients attending for scaling and polishing are screened with appropriate tools like MDAS while awaiting the procedure. **Keywords:** Dental Anxiety, MDAS, Pain, Scaling and Polishing, VAS.

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INTRODUCTION

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage [1]. Pain is also defined as an unpleasant sensation associated with actual or potential tissue damage and mediated by specific nerve fibres to the brain, where its conscious appreciation may be modified by various factors [2]. The later definition recognizes that pain is composed of an inflammatory component, a psychological component and a modulatory component. It has been suggested that on-going inflammation, psychological, functional or structural disturbances within the nervous system result in sensation of pain [3]. In the general population, it is noted that 60% of those above 15years have reported pain at least once [4]. Pain was reported in more than 10% of the study population by Naik et al., [5] and Mei et al., [6] Pain is associated not only with physical stimulation, but also

with emotional and psychological factors. Perception of pain by an individual is determined by degree of nociceptive stimulation, cognitive as well as emotional factors [3]. Hence, the emotional state of an individual modulate his reactivity to pain [1]. Guzeldemir et al., found that age, smoking and oral health status affect patients' perception of pain and dental anxiety [3]. Significant correlation was also reported between anxiety and female gender [16].

Dental anxiety and dental fear are used to describe strong negative feelings experienced by patients in relation to dental treatments. Dental anxiety has been described as a state of ill-feeling that something terrible is going to happen in relation to all or some aspect of dental treatment [7]. It also describes a non-stimulus specific general state of an individual consisting of somatic, cognitive, and emotional elements [5]. Varied prevalence have been reported for

dental anxiety in Nigerian studies; 7%, 21.2% and 48.6% by Arigbede *et al.*, Umanah *et al.*, and Coker *et al.*, respectively [8-10]. Outside Nigeria, prevalence of 13.2% was reported in Tanzania, 47.3% from Ghana, 46% from India and 51.6% among patients in Saudi-Arabia [11-14].

Scaling and polishing, a procedure which involves mainly supragingival calculus removal is the first step in routine dental care and maintenance visits, as well as the initial and essential phase in the treatment of gingivitis and periodontitis. Periodontal procedures have been reported to be associated with pain and high level of anxiety in patients [2]. A relationship between dental anxiety and pain experienced during scaling procedures and pain response after periodontal surgery has been suggested [2]. Perception of pain is a multifaceted emotional and sensory experience that is influenced by previous experience, expected stress, clinical situation and anxiety; hence varies from one person to another [15].

Dental anxiety and fear make patients not to seek dental care and to postpone appointments; the resultant of which is poor oral health [7, 17]. It may interfere with patients' compliance and cause deterioration of dental and periodontal health [7]. The experience of pain during preventive treatments and probing, also may discourage patients whose periodontal health is relatively fair [2]. Most studies in literature dealt with either the level of pain or anxiety among dental patients but information on the effect of level of anxiety on pain perception is scarce. Dental anxiety among Nigerians was reported to be high (48.6%) with up to 25% of Nigerian population avoiding dental treatment except when they are symptomatic [10, 17, 18].

Hence, evaluation of the relationship between anxiety level and pain perceived during treatment is pertinent in order to determine if there is need for pre-treatment anxiolytic intervention which may result in preventive and therapeutic periodontal treatment becoming more pleasant and acceptable to the patient. Also, studies on the relationships between pain and dental anxiety were found to be few in Nigeria and other sub-Saharan countries. Therefore, a study on this important topic cannot be over justified.

This study therefore, set out to determine patients' perception of pain during scaling and determine its relationship with their level of dental anxiety. It also evaluated differences in the pain perception between genders and its relationship with age.

METHODOLOGY

Setting

The study was conducted at the Periodontology Unit of the Dental Centre of the Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, Nigeria. LASUTH is a government-owned tertiary hospital located in Ikeja, the capital city of Lagos State, Southwestern region of Nigeria. It provides referral services for residents of Lagos state and its environs from varying economic and educational levels. The hospital is a state owned institution which was initially established as a General hospital and later evolved to a teaching hospital in July 2001. The hospital is situated in Ikeja Local Government Area which is also one of the most populous local governments in the state. The outpatient department of the Lagos State University Teaching Hospital (LASUTH), the center for the study, receives an average of about 10,000 patients per month of all age groups because of its central location and being the recipient tertiary hospital for the 26 general hospitals in the state. The Oral diagnosis unit of the Dental Centre attends to an average of 514 new patients per month and more than fifty percent of these patients are referred to periodontology unit for various form of periodontal therapy. Nearly all patients seen at the periodontology unit have scaling and polishing as first line treatment.

Participants

The study population were adult patients reporting to the Periodontology Unit of the Dental Centre, Lagos State University Teaching Hospital (LASUTH), Ikeja for professional calculus removal i.e. scaling and polishing; within a period of 3months (February 2019-April 2019).

Sampling and study design

The study was a cross-sectional survey. The required sample size "n" that was determined based on the formula [19]:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where n = sample size, Z = Z statistic for a level of confidence, P = expected prevalence and d = level of precision. The actual sample size "n_a" was then calculated based on the formula [19]:

$$n_a = \frac{n}{1 + [(n-1)/N]}$$

Where n_a = the actual sample size, n = the required sample size and N = population size

For this study, prevalence (P) of dental anxiety was assumed to be 7.43% from a previous study⁸; and the population size (N) 396, the average number of patients that presented for scaling and polishing within

3months (February 2019-April 2019).

Step 1

$$Z = 1.96, P = 7.43\%, d = 0.05$$

$$n = \frac{1.96^2 \times P(1-0.0743)}{0.05^2} = \frac{3.84 \times 0.07}{0.0025} = 107.5 \text{ approx. } 108$$

Step 2

$$n = 108, N = 396$$

$$n_a = \frac{108}{1 + [(108 - 1)/396]} = \frac{108}{1 + [(107)/396]} = \frac{108}{1.27} = 85.04 \text{ approx. } 85$$

Thus, putting non-response rate at 10%, the sample size arrived at for this study was ninety-four (94).

Inclusion Criteria

1. 18years of age and above
2. Presence of supragingival calculus on the mandibular anterior teeth
3. Absence of dentin sensitivity to air stimulation
4. Absence of gingivitis with sulcus depth <4 mm
5. Absence of restorations on mandibular anterior teeth (root canal treatment, composite, amalgam, aesthetic or prosthetic restorations) or orthodontic treatment.

Exclusion Criteria

1. Patients with obvious medical or psychological disorder that might affect pain thresholds.
2. Those using pain or anxiety drugs.
3. Cigarette smokers
4. Alcoholism
5. Acute periodontal pain or infection, pulpitis, abscesses, attachment loss, gingival recession, root hypersensitivity.
6. Refusal to give inform consent.

Examination of the oral condition was carried out and those who met the inclusion criteria were selected.

Measures

1. Sociodemographic data was recorded on a self-administered questionnaire.
2. Visual Analog Scale (VAS) was used to record the patient's pain level. VAS employs a 100-mm horizontal line on which patients indicate their level of pain as a distance from the beginning of the line; zero translates to 'no pain and discomfort' while 100 translates to 'the worst possible pain and discomfort'. The VAS score was recorded as the distance in millimeters from the beginning of the scale. VAS has been reported to be a valid

measurement tool for evaluating dental pain which is simple to use, reliable, reproducible and sensitive [20, 21].

3. Modified Dental Anxiety Scale (MDAS) was used to measure dental anxiety. MDAS consists of five questions and has previously been validated and found suitable for use in Nigeria [10]. Responses are rated with a five-point scale, ranging from Not Anxious (score of 1) to Extremely Anxious (score of 5) and then summed to produce a total score. The MDAS has empirically devised cut-off points where scores above a certain level indicate the possibility of dental anxiety, as follows: 5 to 9 = not dentally anxious, 10 to 18 = High dental anxiety, and 19 to 25 =Very high Dental anxiety (HDA)
4. Simplified Oral Hygiene index (OHI-S) scores, Bleeding Index scores and Gingival Index scores were noted.

Procedures

All participants that gave verbal and written consents took part in the study. The aim and objectives of the study was explained to them. All procedures were performed by the same operator with patients sitting in the same dental chair. Oral examination was carried out on all participants to assess:

Oral hygiene (OH) status using the Simplified Oral Hygiene index (OHI-S) of Green and Vermillion which is made up of the sum of two components; debris and calculus, each of which is scored on a scale of 0 to 3. The OH status was grouped into; good (0.1–1.2), fair (1.3–3.0), and poor (3.1–6.0).

Gingival health status was assessed using Gingival Index (GI) and Bleeding on probing Index. Based on GI index score, the gingiva was regarded as not inflamed when the score was 0, 0.1 – 1.0 mild inflammation, 1.1 – 2.0 moderate inflammation and 2.1 – 3 as severe inflammation. Bleeding on Probing index of greater than 10% was regarded as gingivitis.

Supra-gingival scaling was performed on the six mandibular anterior teeth of all the participants. This was done manually using supragingival scalers of same size and by ultrasonic method using the same handpiece and tips without the use of local anaesthesia. Thereafter, patients were informed of the study protocol to avoid exaggerated responses; and written informed consent was obtained from the patients before participating in the study. All consented patients were then asked to indicate their level of pain on the VAS and complete the questionnaire to assess dental anxiety as well as to record their sociodemographic characteristics. Scaling of the whole mouth was afterwards completed for each patient followed by proper periodontal care and treatment. Subgingival scaling was scheduled for another visit where subgingival calculus was detected.

Ethical Approval

Permission to carry out the research was obtained from the Health Research and Ethics Committee of Lagos State University Teaching Hospital (LASUTH).

Statistical analysis

The data was recorded and analyzed using the statistical software SPSS version 20. Mean and standard deviation was calculated for quantitative variables. Student's t-test was used to test for association between categorical variables. Gender and age differences between Anxiety Scores and VAS was compared using Student's unpaired t-test and ANOVA respectively. The relationship between VAS and each question in the dental anxiety questionnaire was also evaluated. P-value < 0.05 was considered to be statistically significant.

RESULTS

Table 1 presents the socio-demographic characteristics of the study participants. The participants were widely distributed across all age groups with the highest (24; 25.5%) and lowest (8; 8.5%) proportion in age group 56-65 years and below 20 years respectively; and a mean of 46.81 years \pm 18.12. Majority had a tertiary level of education (55; 58.5%), from the lower socio-economic class (44; 46.8%) and mainly of the Yoruba Tribe (61; 64.9%). There was no significant difference in the sociodemographic characteristics of the males and females except in the socio-economic class where there were significantly more females from lower socio-economic class [(25; 55.6%) ($p=0.040$)].

Table 2 presents the Mean Scores MDAS scores according to gender and age groups. Females had higher MDAS scores across all questions in MDAS and this was significant for question 4 "You are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments

which he will use to examine your teeth around the gums, how do you feel?" ($p=0.009$) They also had higher overall Mean MDAS scores (12.87 ± 4.79) than the males. Similarly, respondents aged 18-40 years of age had higher Mean MDAS Score across all questions and also higher overall mean MDAS scores (12.00 ± 4.65) than those aged 41-85 years even though the association was not significant.

Table 3 presents the level of dental anxiety among respondents according to gender and age group. The prevalence of high dental anxiety in the entire sample (MDAS: 15-19) was 24.5% while the prevalence of very high Dental Anxiety (MDAS >19) was 7.4%. There was no significant association between the different genders and age groups though there were more females (5; 11.1%) and respondents aged 41-85 years (5; 8.5%) with very high dental anxiety.

Table 4 presents the periodontal parameters of respondents in relation to age and gender. Females had higher OHI-S scores (2.57 ± 1.22), Bleeding (Bleeding on Probing) Index scores (48.57 ± 39.38), Gingival Index (1.57 ± 0.58) scores than males though the association was not significant. Female gender had higher proportion with poor OH status (26.7%) and severe gingival inflammation (8.9%) than their male counterpart (16.3% & 2.0% respectively), but not statistically significant. Similarly, those aged 41-85 years had higher mean OHI-S scores (2.50 ± 1.10), Bleeding Index scores (47.04 ± 38.67), Gingival Index (1.49 ± 0.54) scores than those aged 18-40 years old, though the association was not significant. More than half of both young and older age groups had fair OH status and moderate gingival inflammation. However, no significance was recorded.

Table 5 presents the mean VAS scores and pain intensity elicited among the respondents according to age and gender. Mean VAS score of the entire study population was 29.68 ± 22.94 . Females had higher mean VAS scores (31.44 ± 23.44) than males, the association however, was not significant. Similarly, those aged 18-40 years had higher mean VAS scores (31.44 ± 23.44) than those aged 41-85 years though the association was not significant.

Table 6 displays the relationship between different variables and pain intensity. The proportion of patients that experienced moderate to severe pain during scaling increased as the OH status became poorer (good; 17.6%, fair; 29.9%, poor; 40.0%) and with increased gingival inflammation (No inflammation; 0%, mild; 27.6%, moderate; 30.5%, severe; 40%). The proportion of patients with severe pain increased as the dental anxiety (DA) increased (No DA; 3.2%, high DA; 4.3%, very high DA; 14.2%). However, these differences failed to demonstrate significant association.

Table 1: Sociodemographic Characteristics

Number (n)	Overall	Male	Female	P-value
Age Range (yr)	94 (100%)	49 (52.1%)	45 (47.9%)	
Mean age(yr)	18 - 85yrs	18 - 75yrs	18 - 85yrs	
Median (yr)	46.81±18.12 47.50	45.71±17.55 47.0	47.98±18.85 50.00	
Age group				
<20yrs	8 (8.5%)	4 (8.2%)	4 (8.9%)	0.681
20yrs-35yrs	20 (21.3%)	11 (22.4%)	9 (20.0%)	
36yrs-45yrs	17 (18.1%)	8 (16.3%)	9 (20.0%)	
46yrs-55yrs	9 (9.6%)	7 (14.3%)	2 (4.4%)	
56yrs-65yrs	24 (25.5%)	12 (24.5%)	12 (26.7%)	
>65yrs	16 (17.0%)	7 (14.3%)	9 (20.0%)	
Educational Level				0.376
None	3 (3.2%)	0 (0.0%)	3 (6.7%)	
Primary	6 (6.4%)	4 (8.2%)	2 (4.4%)	
Junior secondary	5 (5.3%)	2 (4.1%)	3 (6.7%)	
Senior secondary	25 (26.6%)	14 (28.6%)	11 (24.4%)	
Tertiary	55 (58.5%)	29 (59.2%)	26 (57.8%)	
Socioeconomic class				0.040*
Upper	21 (22.3%)	16 (32.7%)	5 (11.1%)	
Middle	29 (30.9%)	14 (28.6%)	15 (33.3%)	
Lower	44 (46.8%)	19 (38.8%)	25 (55.6%)	
Ethnicity				
Yoruba	61 (64.9%)			
Hausa	1 (1.1%)			
Igbo	19 (20.2%)			
Others	13 (13.8%)			
Religion				
Christianity	80 (85.1%)			
Islam	13 (13.8%)			
Others	1 (1.1%)			

*Significant

Table 2: Mean Scores for each VAS score and MDAS scores according to gender, young and older age groups

	Mean MDAS Score					
	Q1	Q2	Q3	Q4	Q5	Total
Entire group	2.07±1.20	2.11±1.30	2.83±1.37	2.27±1.26	2.61± 1.28	11.88±4.87
Gender						
Male	2.02±1.25	1.92±1.24	2.57±1.41	2.16±1.42	2.31±1.21	10.98±4.80
Female	2.13±1.16	2.31±1.35	3.11±1.27	2.38±1.07	2.93±1.29	12.87±4.79
P-value	0.691	0.463	0.066	0.009*	0.206	0.531
Young & Older age group						
18-40yr (Young)	2.00±1.28	1.91±1.25	3.06±1.45	2.29±1.23	2.74±1.29	12.00±4.65
41-85yr (Older)	2.12±1.16	2.22±1.33	2.69±1.30	2.25±1.29	2.53±1.28	11.81±5.03
P-value	0.620	0.837	0.316	0.905	0.941	0.782

*Significant Q= MDAS Question

Table 3: Level of anxiety according to gender and age group

	Level of Dental Anxiety(DA)			p-value
	No DA MDAS 0-14	High DA MDAS 15-19	Very High DA MDAS >19	
Entire group	64 (68.1%)	23 (24.5%)	7 (7.4%)	
Gender				
Male	36 (73.5%)	11 (22.4%)	2 (4.1%)	0.339
Female	28 (62.2%)	12 (26.7%)	5 (11.1%)	
Young & Older age group (yr.)				
18-40 (young)	25(71.4%)	8 (22.9%)	2 (5.7%)	0.829
41-85 (older)	39 (66.1%)	15 (25.4%)	5 (8.5%)	

Table 4: Periodontal Parameters in relation to age and gender

	Mean \pm SD			OH status			Inflammation severity			
	OHI-S score	BI score	GI score	Good	Fair	Poor	None	Mild	Moderate	Severe
Entire group	2.37 \pm 1.11	45.44 \pm 38.76	1.49 \pm 0.55	17 (18.1%)	57 (60.6%)	20 (21.2%)	1 (1.1%)	29 (30.9%)	59 (62.8%)	5 (5.3%)
Gender										
Male	2.19 \pm 0.97	42.57 \pm 38.37	1.40 \pm 0.49	10 (20.4%)	31 (63.3%)	8 (16.3%)	0 (0.0%)	19 (38.8%)	29 (59.2%)	1 (2.0%)
Female	2.57 \pm 1.22	48.57 \pm 39.38	1.57 \pm 0.58	7 (15.5%)	26 (57.8%)	12 (26.7%)	1 (2.2%)	10 (22.2%)	30 (66.7)	4 (8.9%)
<i>P</i> -value	0.492	0.511	0.408	0.449			0.142			
Young & Older age group										
18-40yr	2.16 \pm 1.10	42.74 \pm 39.33	1.47 \pm 0.54	9 (25.7%)	20 (57.21%)	6 (17.2%)	0 (0.0%)	11 (31.4%)	22 (62.9%)	2 (5.7%)
41-85yr	2.50 \pm 1.10	47.04 \pm 38.67	1.49 \pm 0.54	8 (13.6%)	37 (62.7%)	14 (23.7%)	1 (1.7%)	18 (30.5%)	37 (62.7%)	3 (5.1%)
<i>P</i> -value	0.322	0.524	0.391	0.308			0.893			

Table 5: Mean VAS score and pain intensity according to age and gender

	Mean VAS score	Intensity of Pain				<i>P</i> -value
		No Pain	Mild Pain	Moderate Pain	Severe Pain	
Entire group	29.68 \pm 22.94	10 (10.6%)	56 (59.6%)	24 (25.5%)	4 (4.3%)	
Gender						
Male	28.06 \pm 22.59	5 (10.2%)	32 (65.3%)	10 (20.4%)	2 (4.1%)	0.650
Female	31.44 \pm 23.44	5 (11.1%)	24 (53.3%)	14 (31.1%)	2 (4.4%)	
Young & Older age group						
18-40yrs (young)	30.57 \pm 21.92	4 (11.4%)	19 (54.3%)	11 (31.4%)	1 (2.9%)	0.727
41-85yrs (older)	29.15 \pm 23.69	6 (10.2 %)	37 (62.7%)	13 (22.0%)	3 (5.1%)	

Table 6: Relationship between different variables (OH status, severity of inflammation, anxiety level) and pain intensity

	Intensity of Pain				<i>P</i> -value
	No Pain (VAS 0-4)	Mild (VAS score 5-44)	Moderate (VAS score 45-74)	Severe (VAS score 75-100)	
OH Status					0.845
Good	2 (11.8%)	12 (70.6%)	3 (17.6%)	0 (0.0%)	
Fair	6 (10.5%)	34 (59.6%)	14 (24.6%)	3 (5.3%)	
Poor	2 (10.0%)	10 (50.0%)	7 (35.0%)	1 (5.0%)	
Severity of inflammation					0.370
None	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Mild	3 (10.3%)	18 (62.1%)	7 (24.1%)	1 (3.5%)	
Moderate	6 (10.2%)	35 (59.3%)	15 (25.4%)	3 (5.1%)	
Severe	0 (0.0%)	3 (60.0%)	2 (40.0%)	0 (0.0%)	
Level of Dental Anxiety(DA)					0.164
No DA	10 (15.6%)	39 (60.9%)	13 (20.3%)	2 (3.2%)	
Moderate DA	0 (0.0%)	14 (60.9%)	8 (34.8%)	1 (4.3%)	
Very high DA	0 (0.0%)	3 (42.9%)	3 (42.9%)	1 (14.2%)	

DISCUSSION

This study provides information about pain perception and dental anxiety during scaling and polishing among a sample of Nigerian patients. The effective removal of plaque and prevention of the recolonization of pathogenic organisms are required to maintain optimum periodontal health and for primary and secondary prevention of periodontitis [22]. However, this procedure may also be associated with anxiety which is an emotional reaction that is defined as

stress or nervousness due to a perceived risk and autonomic nervous system activity [23]. This may result in avoidance of periodontal recall appointments [24].

Majority of the participants in this study were aged between 56-65 years, had a tertiary level of education and from the lower socio-economic class. An unpleasant dental experience has a strong impact on dental anxiety. With regards to self-assessed dental anxiety, females had higher MDAS scores across all question categories in MDAS and this was most

significant for anxiety related to sitting in the dentist's chair and awaiting the scaling and polishing procedure. This outcome is consistent with previous literature suggesting that females are more likely to be diagnosed with anxiety and phobia-related problems [25], because they are more responsive to specific stimuli such as fear of the needles they also display more anxiety-related characteristics. Younger respondents in this study similarly had higher mean MDAS Score across all question categories than those who were elderly. Dental anxiety often peaks in adolescence and declines with age. Thus, older people have lower scores on dental anxiety measures than younger individuals, particularly after 50 years of age [26].

Furthermore, females and younger respondents had higher mean VAS scores on assessing pain experience during the dental scaling and polishing procedure. Pain experience is influenced not only by mechanical stimuli but also by psychological factors, patients' pain history, and previous dental experiences. The intensity of pain or discomfort has been perceived by practitioners to differ dramatically between patients [27]. Large-scale epidemiological studies across multiple geographic regions documented that pain is reported more frequently by women than by men [27]. It has been suggested that an interaction of biological, psychological, and sociocultural factors likely contribute to these differences. Oestradiol and progesterone's exerts both pro-nociceptive and anti-nociceptive effects on pain sensitivity [28], while testosterone appears to be more anti-nociceptive and protective in nature [28]. Sociocultural beliefs about femininity and masculinity also appear to be important determinants of pain responses among the sexes as pain expression is generally more socially acceptable among women, an effect which may lead to more frequent reporting of pain.

A higher proportion of patients with very high Dental anxiety had more subjects with moderate (42.9%) and severe VAS pain scores (14.2%) in this study. Also, the proportion of patients with severe pain increased as the dental anxiety (DA) increased. Dental anxiety has also been found to have a direct relationship with pain perception even though the stronger association in this study was not statistically significant. Rhudy and Meagher [30] suggested that the pain reactivity is modulated by emotional stress. In addition, Loggia *et al.*, [31] documented changes in pain pathways on neuroimaging techniques with a negative emotional state. Furthermore, Klages *et al.*, [32] revealed that anxiety increases expected or experienced pain while patients with higher anxiety levels experienced a higher pain.

There is strong and consistent evidence that dental fear is related to poorer oral health, reduced dental visiting and poorer oral health-related quality of life [33, 34]. A painless treatment increases patients'

comfort during scaling and polishing, and might therefore increase patients' compliance. This in turn may provide a better long-term prognosis for periodontal therapy. Fear of treatment could affect patient compliance and result in deterioration of the periodontal health. Pain experience after dental work is amongst the most common distressing life experiences, and has been seen to trigger psychological trauma and a persistent fear of the dentist among patients [35]. Not surprisingly, oral health among patients with dental anxiety and dental phobia is worse compared to that of the regular population, thus propagating a vicious cycle.

Reducing supra and sub-gingival plaque and calculus as well as preventing recolonization of periodontal pockets by pathogenic bacteria are fundamental aspects of periodontal therapy. Therefore, dental plaque, an adherent, bacterial biofilm that forms on soft and hard tissues and calcified deposits should be removed from the tooth surface employing hand scalers, ultrasonic instruments and air-powder abrasive scalers. In this study, a higher proportion of patients with worse oral hygiene and gingival inflammation had moderate to severe VAS rated pain scores. This seem plausible since a higher deposit of debris, plaque and calculus will require a longer period to be thoroughly removed while an inflamed gingiva will bleed more and also be more irritated during the scaling procedure. Thus, patients with worse oral hygiene may be expected to experience more discomfort during the procedure.

Despite reductions in pain associated with dental visits and an increased awareness by dentists of the importance of building trusting relationships, dental fear remains a major concern for dental clinicians and their patients. A number of studies have found an association between dental fear and both visiting patterns and disease experience. For example, Schuller *et al.*, [36] found that individuals with high fear visited the dentist less often and had poorer oral health. Similarly, Thomson *et al.*, [37] found associations between dental fear and less frequent dental visiting, increased visiting for a problem and increased social and functional impairment. According to a survey by Berggren and Meynert, painful dental work is the most commonly mentioned reason for fear in dentistry among adults [38, 39]. Therefore, delivering dental treatment with minimal pain can positively affect patients' compliance and improve treatment success. Patients undergoing life-long supportive periodontal therapy may have poor compliance if previous treatment was perceived as painful. It is recommended that patients attending for scaling and polishing are screened with appropriate tools like MDAS while awaiting the procedure. In addition, appropriate behavioural modification and pharmacologic interventions should be incorporated into scaling and polishing and other periodontal maintenance procedures.

A limitation of this study is that previous negative dental experiences as well as negative perceptions by new patients could have confounded the results obtained from the respondents.

CONCLUSION

Scaling and polishing was associated with increased pain and anxiety levels among females and younger respondents while patients with worse oral hygiene and gingival inflammation experienced more discomfort during the procedure. The proportion of patients that experienced severe pain increased with increased dental anxiety but the association was not significant. It is recommended that patients attending for scaling and polishing are screened with appropriate tools like MDAS while awaiting the procedure to identify patients with high dental anxiety that may require pre-treatment anxiolytic therapy. Treatment with minimal pain can positively affect patients' compliance and improve treatment outcomes.

Declaration of Interests: All authors declare no conflicts of interest.

We believe that the manuscript represents valid work. Neither this manuscript nor one with substantially similar content under my/our authorship has been published or is being considered for publication elsewhere, except as described in the covering letter. I certify that all the data collected during the study is presented in this manuscript and no data from the study has been or will be published separately. The manuscript has been read and approved by all the authors, that the requirements for authorship has been met. We attest that, if requested by the editors, we will provide the data/information or will cooperate fully in obtaining and providing the data/information on which the manuscript is based, for examination by the editors or their assignees. Financial interests, direct or indirect, that exist or may be perceived to exist for individual contributors in connection with the content of this paper have been disclosed in the cover letter. Sources of outside support of the project are named in the covering letter and duly acknowledged in the manuscript.

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