

Psychosocial Impact of Tooth Discoloration among 12 to 15-Year-Old School Children in Ibadan North West Local Government Area of OYO State, Nigeria

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ABSTRACT

Background: Aesthetic changes in tooth appearances have been reportedly associated with potentially negative impact on adolescents' oral health-related quality of life. This study, therefore, aims to explore the relationship between tooth discoloration and its psychosocial impact on adolescents.

Methodology: A cross-section of 374 twelve- to fifteen-year-olds were recruited into the study using multistage sampling. Information on biodata and psychosocial impact of tooth discoloration were obtained. Participants were examined for the presence of tooth discoloration using the Developmental Defects of Enamel and Deans indices. Psychosocial impact of tooth discoloration was measured using Oral Health Impact Profile. Analysis was done using chi-square and binary logistic regression.

Results: The prevalence of tooth discoloration among the participants was 212 (56.7%), with 136 (36.4%) of participants having extrinsic stains as the commonest cause. Psychosocial impact was significantly associated with self-perception ($p=0.000$) of tooth as being discolored and not associated with the actual presence or absence of tooth discoloration on examination ($p=0.208$).

Conclusion: The self-perception of tooth discoloration appears to have greater tendency to cause psychosocial impact than the actual presence of tooth discoloration. Adolescents should be given oral health education on tooth discoloration in schools.

Keywords

Tooth discoloration, Oral health-related quality of life, Self-perception, Psychosocial.

Introduction

Visible changes in the color of the tooth have been reported to be one of the earliest signs of variation in the normal structural

composition and perhaps function of the dentition [1]. Dental conditions resulting in such variations are either inherited or acquired, with a potential adverse effect on the tooth during its formation, development and afterward. Self-assessment of tooth discoloration amongst residents living in the UK, revealed general dissatisfaction with their teeth color, and suggested treatment of tooth discoloration be incorporated into planning dental services

[2]. Aesthetic changes in tooth appearances have been reportedly associated with potential negative impact on adolescents' oral health-related quality of life (OHRQoL) [3]. The contribution of the dentition in the general aesthetic appearance of humans cannot be overemphasized, more so in adolescents as it appears to play a critical role in how they rate their OHRQoL [3].

A widely used means of classification of tooth discoloration is based on the etiology which could be intrinsic, extrinsic, or a combination of both [1]. Intrinsic involves the deposition of chromatogenic substances in the enamel and dentine during the formative stage or post-eruptive by local or systemic means. The most implicated causes are dental fluorosis, tetracycline staining, inherited developmental anomalies, pulpal necrosis, aging, trauma to developing tooth, and iatrogenic causes [4]. Extrinsic discoloration involves the deposition of chromatogenic materials on the acquired pellicle on tooth surfaces, common sources of which are tea, herbs, red wine, tobacco, and coffee amongst others [1,5]

Several foreign and local studies have reported the aesthetic concerns of tooth discoloration. Chadwick et al., [6] in a survey of British children reported that 34% of twelve year old's had visible enamel opacities involving one or more permanent incisors. The National Health and Nutrition Examination Survey (NHANES) in a study on dental fluorosis [7] carried out from 1999 – 2004, reported that 23% of the US population had dental fluorosis and this was particularly common amongst adolescents aged 12 to 15 years. In Nigeria, a retrospective study of 136 patients by Gbadebo et al., [8] reported that tooth discoloration was a major cause of presentation at the university college hospital due to aesthetic concerns and reduced self-esteem. They further reported that pulpal necrosis was the most common cause of presentation (8.8%) while fluorosis was the least reported (0.7%) among 136 patients [8].

Rodd et al., [3] in a study of 216 respondents aged 10 and 11, explored the impact of gender, visible dental differences and self-reported dental appearance satisfaction on children's Oral Health Related Quality of Life (OHRQOL) during transition from primary to secondary school. They reported higher dissatisfaction levels with visible incisor differences, along with an ultimate potential to negatively impact on the children's OHRQoL. However, another study by Marshman et al. [9] showed the impact on oral health related quality of life and psychosocial life was highly subjective and depended on adolescents' perception of their own appearance. Oyedele et al. [10] also reported that Molar incisor hypomineralization amongst 8 to 16 year old's who were susceptible to caries, dentine hypersensitivity, aesthetic concerns was found to negatively affect their OHRQoL. Ibiyemi and Taiwo [11] in a study conducted on the psychosocial aspect of anterior tooth discoloration among adolescents in Igbo-Ora reported extrinsic stains as the major source of tooth discoloration, with a majority of participants also reporting one form of psychosocial effect or the other.

There is paucity of literature on the prevalence and psychosocial impact of tooth discoloration amongst adolescents in Nigeria. This study therefore aims to explore the relationship between tooth discoloration, its self-perception and its impact on the emotional, psychological, social well-being and development of adolescents, a delicate group of the population. The knowledge of such will not only help in management but also foster the prevention of tooth discoloration, create awareness on its causes, and perhaps shape the nature of oral health education and promotion delivered to adolescents in secondary schools.

Methodology

This study was a cross-sectional study carried out within 4 weeks amongst 12 to 15-year-old public secondary school children resident in Ibadan North West Local Government Area, Ibadan, Oyo state, Nigeria. Ethical review board exemption and permission to undertake the study were obtained from the Dean Faculty of Dentistry, University of Ibadan since the study formed part of the community dentistry undergraduate curriculum. The study was undertaken in accordance with ethical standards provided by the Declaration of Helsinki. All participants gave assent to participate after written informed consent was obtained from their parents or guardians. Permission to undertake the study in the schools was also obtained from the respective school authorities. Children who did not fall within the age group of the study participants, non-consenting parents' children, those unwilling to participate and were ill were all excluded from the study.

Sample size was calculated using the Leslie Kish [12] formula for cross-sectional studies. The standardized normal deviate corresponding to a 2-sided level of significance at 5% was 1.96 and the level of precision set at 10%. The prevalence of tooth discoloration of 64% obtained from a previous study on extrinsic tooth discoloration amongst 11 to 16 year old's in Nigeria by Koleoso et al. [13] was used to determine p in the formula. Design effect was taken into consideration such that the intraclass correlation coefficient and average cluster size gotten from the pilot study were 0.2 and 16 respectively, thus we adjusted the sample size by multiplying by a factor of 4 (calculated design effect). A 95% response rate was assumed, hence the minimum sample size required was calculated to be 371.

A multistage cluster sampling method was used to recruit study participants into the study. A list of all the 11 wards in Ibadan northwest LGA was obtained from its administrative secretariat and 1 ward was randomly selected by balloting from this list. A list of all the secondary schools in the randomly selected ward was then obtained from the Local Government Education Authority and 2 schools were randomly selected by balloting. Following this, a list of children aged 12 to 15 years in each class and arm in Junior Secondary School 1 (JSS 1) and Senior Secondary School 1 (SSS 1) in each of the randomly selected schools were obtained from the school authorities. All the 12 to 15-year-old children were given a letter inviting them to participate, however, 374 met the inclusion criteria.

Actual tooth discoloration was measured by training of 3 examiners on diagnostic criteria for tooth discoloration was done for a day using clinical photographs of various types of tooth discoloration under a calibrated examiner (O.I) prior to the data collection. Calibration of the examiners was also done using another set of clinical photographs.

A pilot survey in a public secondary school in Ibadan North Local Government Area was done to assess the feasibility of the study, determine the intra-class correlation coefficient, average number of individuals in each class (cluster), comprehensiveness of the interviewer-administered questionnaire, and removal of ambiguous questions.

After the pilot survey, the questionnaire which contained 3 sections: sociodemographic characteristics, participants awareness and care towards tooth discoloration as well as psychosocial impact of tooth discoloration section was corrected. The psychosocial impact of tooth discoloration was measured by the use of 15 item questions adapted from the psychosocial domains of Oral Health Impact Profile (OHIP 49) [14].

The questionnaire was then administered to the study participants in a quiet well-lit room provided by the school authorities. After the questionnaire was administered to the participants, clinical dental examination for the presence of tooth discoloration (enamel defects, extrinsic stains, pulpal necrosis, internal root resorption and tetracycline stains) was undertaken by the 3 trained and calibrated examiners under natural light with participants seated in an upright position on a chair, and examination undertaken with gloves, facemasks and wooden spatulas. A random sample of 38 (10.2%) participants was re-examined and intra and inter-examiner reproducibility determined (Kappa intra- and inter- agreement scores > 90%).

Data were cleaned, entered, and analyzed using Statistical Package for Social Science (SPSS) version 23. Scores were assigned to the Likert scale responses to the questions on psychosocial impact ranging from 0 to 4; 0 = never, 1 = once or twice, 2 = sometimes, 3 = fairly often and 4 = very often. A cumulative total score for psychosocial impact was obtained which ranged from 0 to 60. Scores were then dichotomized into 0 to 30 representing a 'low impact' and 31 to 60 representing 'high impact'.

Frequencies and proportion of categorical variables were reported, while the mean and standard deviation of continuous variable was reported. Bivariate analysis was done using chi-square to test for difference between sociodemographic variables and psychosocial impact of tooth discoloration, while Odds ratio was used to test for the association between awareness and care variables and psychosocial impact of tooth discoloration. Multivariate analysis using binary logistic regression was done to rule out confounders amongst the significant exposure variables associated with psychosocial impact of tooth discoloration.

Results

The mean (SD) age of participants was 13.3 (1.0) years. Table 1 shows that the proportion of males 199 (53.2%) was slightly higher than females and most of the study participants were in JSS classes 314 (84.0%). Christians 275 (73.5%), and Yorubas 236 (63.1%) also dominated religion and tribe respectively among the participants. The majority 192 (51.3%) and 190 (50.8%) reported that secondary school was the highest educational level of their fathers and mothers respectively.

Table 1: Frequency distribution of Sociodemographic characteristics of study participants (n=374).

Sociodemographic characteristics		Frequency No. (%)
Age Group (years) Mean (SD) = 13.3 (1.0)	12 - 13	228 (61.0)
	14 - 15	146 (39.0)
Gender	Male	199 (53.2)
	Female	175 (46.8)
Class	JSS 1	53 (14.2)
	JSS 2	72 (19.3)
	JSS 3	189 (50.5)
	SSS 1	60 (16.0)
Religion	Islam	95 (25.4)
	Christian	275 (73.5)
	Traditional	4 (1.1)
Tribe	Yoruba	236 (63.1)
	Hausa	44 (11.8)
	Igbo	68 (18.2)
	others	26 (7.0)
Father's education	No formal	10 (2.7)
	Primary	25 (6.7)
	Secondary	192 (51.3)
	Tertiary	147 (39.3)
Mother's education	No formal	7 (1.9)
	Primary	37 (9.9)
	Secondary	190 (50.8)
	Tertiary	140 (37.4)

Note: JSS – Junior Secondary School; SSS – Senior Secondary School

Awareness and Care

Table 2 shows 224 (59.9%) of the participants perceived that their teeth were discolored, out of which 84 (37.5%) felt their front teeth were most affected and 130 (58.0%) claimed to have first noticed the discoloration by themselves. One hundred and forty (37.4%) reported that they were aware of the causes of tooth discoloration. One hundred and twenty-eight (62.6%) participants reported that at least one member of their family and friends had discolored teeth and most of the participants 210 (56.15%) reported they only brushed their teeth once daily. The majority of the participants 342 (91.4%) felt tooth discoloration can be made better. Self-perceived causes of tooth discoloration showed that 58 (41.4%) and 56 (40%) of the participants reported dental fluorosis and plaque and calculus respectively as self-perceived causes of tooth discoloration. Amongst those that reported that tooth discoloration can be made better, 156 (45.6%) thought that the best form of care for discoloration is to brush more than twice daily and this is closely followed by a visit to the dentist 105 (30.7%).

Table 2: Frequency distribution of factors associated with tooth discoloration.

Factors associated with tooth discoloration		Frequency No. (%)
Self-perception of tooth discoloration (n=374)	Yes	224 (59.9)
	No	150 (40.1)
To what extent is your tooth discolored (n=224)	Front teeth	84 (37.5)
	Back teeth	53 (23.7)
	Most teeth	50 (22.3)
	All teeth	37 (16.5)
Who first noticed discolored teeth (n=224)	Self	130 (58.0)
	Friends	13 (5.8)
	Family	80 (35.7)
	Teachers	1 (0.5)
Awareness of various ways a tooth can be discolored (n=374)	Yes	140 (37.4)
	No	234 (62.6)
Family and friends with discolored teeth (374)	None	246 (65.8)
	At least one	128 (34.2)
Teeth brushing per day (374)	Once	210 (56.1)
	Twice or more	164 (43.9)
Tooth discoloration can be made better (374)	Yes	342 (91.4)
	No	32 (8.6)

Table 3: Sociodemographic Characteristics and presence of tooth discoloration (n=374).

Sociodemographic Characteristics		Actual Tooth discoloration		X ²	p-value
		Yes No. (%)	No No. (%)		
Age group (years)	12-13	118 (51.8)	110 (48.2)	5.782	0.016*
	14-15	94 (64.4)	52 (35.6)		
Gender	Male	110 (55.3)	89 (44.7)	0.343	0.601
	Female	102 (58.3)	73 (41.7)		
Class	JSS	175 (55.7)	139 (44.3)	0.722	0.395
	SS1	37 (61.7)	23 (38.3)		
Religion (n=370)	Christianity	160 (58.2)	115 (41.8)	0.886	0.346
	Islam	50 (52.6)	45 (47.4)		
Tribe (n=348)	Yoruba	132 (55.9)	104 (44.1)	0.570	0.752
	Hausa	27 (61.4)	17 (38.6)		
	Igbo	37 (54.4)	31 (45.6)		
Father's education	≤ Secondary	120 (52.9)	107 (47.1)	3.434	0.070
	Tertiary	92 (62.6)	55 (37.4)		
Mother's education	≤ Secondary	127 (54.3)	107 (45.7)	1.480	0.237
	Tertiary	85 (60.7)	55 (39.3)		
Self-perception of teeth as being discolored	Yes	136 (60.7)	88 (39.3)	3.694	0.056
	No	76 (50.7)	74 (49.3)		

*Significant at $p < 0.05$

Prevalence and various forms of tooth discoloration

The least kappa value for intra-examiner agreement for the 38 (10.2%) participants re-examined was 0.825 showing excellent agreement while the least inter-examiner agreement was 0.691 indicating good agreement. The prevalence of tooth discoloration among the participants was 212 (56.7%), out of which 136 (36.4%), 51 (13.6%), 34 (9.1%), 9 (2.4%), and 6 (1.6%) of the participants presented with extrinsic stains (plaque and calculus), developmental defects of enamel, dental fluorosis, pulpal necrosis, and tetracycline stains respectively. One hundred and eighty-four (49.2%) of the participants had only one form of tooth discoloration, 26 (7.0%) had a combination of two different forms of discoloration while only 2 (0.5%) had a combination of 3 forms of tooth discoloration.

Socio-demographic characteristics and tooth discoloration

Ninety-four (64.4%) of participants aged 14 – 15 years compared to 118 (51.8%) of those aged 12 – 13 years had tooth discoloration (Table 3). This observation was found to be statistically significantly ($p=0.016$).

Psychosocial impact and discoloration

The majority of the participants 286 (76.5%) had a low psychosocial impact of tooth discoloration. Bivariate analysis shows sociodemographic characteristics like class ($p=0.007$), religion ($p=0.005$), and tribe ($p=0.001$) were significantly related with psychosocial impact of discoloration (Table 4). Bivariate analysis also shows a significant association between psychosocial impact of tooth discoloration and self-perception of tooth as being

Table 4: Relationship between sociodemographic Characteristics and Psychosocial impact (n=374).

Sociodemographic Characteristics		Low impact No. (%)	High impact No. (%)	X ²	p-value
Age group (years)	12-13	172 (75.4)	56 (24.6)	0.346	0.557
	14-15	114 (78.1)	32 (21.9)		
Gender	Male	148 (78.9)	51 (21.1)	1.041	0.308
	Female	138 (74.4)	37 (25.6)		
Class	JSS	232 (73.9)	82 (26.1)	7.270	0.007*
	SS1	54 (90.0)	6 (10.0)		
Religion	Christianity	201 (73.1)	74 (26.9)	8.068	0.005*
	Islam	83 (87.4)	12 (12.6)		
Tribe	Yoruba	189 (80.1)	47 (19.9)	13.109	0.001*
	Hausa	37 (84.1)	7 (15.9)		
	Igbo	41 (60.3)	27 (39.7)		
Father's education	≤ Secondary	164 (77.4)	48 (22.6)	0.122	0.795
	Tertiary	103 (75.7)	33 (24.3)		
Mother's education	≤ Secondary	168 (77.1)	50 (22.9)	0.038	0.896
	Tertiary	99 (76.2)	31 (23.8)		

*Significant at $p < 0.01$.

Table 5: Relationship between Discoloration variables and psychosocial impact (n=374).

		Low impact No. (%)	High impact No. (%)	Odds Ratio	95% CI	p-value
Self-perception of tooth as being discolored	Yes	152 (67.9)	72 (32.1)	3.967	2.200 – 7.152	0.000*
	No	134 (89.3)	16 (10.7)			
Awareness of various ways tooth can be discolored	Yes	100 (71.4)	40 (28.6)	1.55	0.954 – 2.517	0.075
	No	186 (79.5)	48 (20.5)			
Family and friends with discolored teeth	At least one	87 (68.0)	41 (32.0)	1.995	1.224 – 3.253	0.005*
	None	199 (80.9)	47 (19.1)			
Brushing frequency per day	At least twice	133 (81.1)	31 (18.9)	0.626	0.318 – 1.027	0.062
	Once	153 (72.9)	57 (27.1)			
Tooth discoloration can be made better	Yes	258 (75.4)	84 (24.6)	0.439	0.150 – 1.287	0.124
	No	28 (87.5)	4 (12.5)			
Actual Tooth discoloration on examination	Yes	157 (74.1)	55 (25.9)	1.369	0.839 – 2.236	0.208
	No	129 (79.6)	33 (20.4)			

CI = Confidence Interval; * $p < 0.01$.

Table 6: Binary logistic regression showing predictors of high psychosocial oral health impact.

Predictors of psychosocial impact	β	Significance	OR (exp β)	95% CI	
				lower	upper
Class (reference SSS1)	0.873	0.091	2.395	0.869	6.603
Religion (reference Christian)	-0.768	0.038*	0.464	0.225	0.957
Tribe (reference Yoruba)					
Hausa	-0.428	0.380	0.652	0.250	1.695
Igbo	0.789	0.018*	2.201	1.143	4.236
Self-perception of discoloration (reference NO)	1.358	0.000**	3.888	1.982	7.627
Family and friend with discolored teeth (reference NONE)	0.212	0.345	1.313	0.747	2.308

$X^2(6) = 47.065$; * $p < 0.05$; ** $p < 0.001$; $R^2 = 0.194$; β = Beta Coefficient, CI = Confidence Interval, OR=Odds ratio.

discolored (OR = 3.967, CI = 2.200 – 7.152, $p = 0.000$) and presence of a family or friend with tooth discoloration (OR = 1.995, CI = 1.224 – 3.253, $p = 0.005$) (Table 5).

To rule out confounders, Table 6 shows a logistic regression performed to ascertain the role of class, religion, tribe, awareness of tooth discoloration and presence of a family/friend with discolored tooth on the likelihood that a student has high psychosocial oral health impact. An Islamic student was 2.16 times less likely to have a high psychosocial impact from tooth discoloration compared to

a Christian student. An Igbo student was 2.2 times more likely to have a high psychosocial impact from tooth discoloration compared to a Yoruba student (OR = 2.2; CI = 1.1 – 4.2; $p = 0.02$). A student who has a self-perception of tooth discoloration is 3.9 times more likely to have a high psychosocial impact than one who doesn't have such self-perception (OR = 3.9; CI = 1.98 – 7.63; $p = 0.0001$).

Discussion

We discovered a tooth discoloration prevalence of 56.7% after thorough intraoral examination of participants, while 59.9%

of the study participants perceived they had one form of tooth discoloration or the other. The direction of our finding seems to contrast to that reported by Ibiyemi et al. [15] in 2017 where tooth discoloration found on intraoral examination exceeded that perceived by study participants. Superficially, one may be tempted to assume a high level of agreement exist between the actual prevalence and the self-perception, but further scrutiny reveals no agreement ($k=3.1\%$) between them.

This may be attributed to the inability of participants to adequately access and diagnose posterior discolorations. Furthermore, the participants might also be unable to evaluate some forms of tooth discoloration such as enamel opacities and fluorosis as a significant aesthetic problem. This disparity between self-perception and intra-oral finding was also discovered between gender, males in our study had a greater proportion of self-perception but a lower proportion of intraoral discoloration after examination compared to females. This difference was found to be statistically insignificant, suggestive of gender playing a reduced role in the self-perception of tooth discoloration among adolescents, which is similar to the conclusion by Burden and Pine [16] on self-perception of malocclusion among adolescents.

Participants' knowledge of causes of tooth discoloration seems to be quite low (37.4%), though they seem to have substantial knowledge of how and whom to seek for care for a better teeth appearance. Their substantial knowledge on seeking health care seems to differ from that reported by Ibiyemi et al., [15] which reported about 82% of their participants had a poor knowledge on care of discolored tooth. Perhaps the difference in exposure to oral health care and education might have been responsible for this difference as their study was carried out in a rural community without any oral health care facility. Extrinsic stains mainly due to plaque and calculus were responsible for the highest form of discoloration. This is similar to previous study by Koleoso et al. [13] amongst 11 to 16 year old's Nigerian children.

In our study, we found out that participants in SSS had a marginally higher proportion of discolored teeth after intraoral examination, but a significantly lower psychosocial impact compared to JSS students. Further scrutiny of our data shows that the self-perception of having tooth discoloration amongst JSS students (65%) was almost twice that of SSS 1 students (33.3%). This perception and awareness amongst them (JSS) have perhaps led to the higher psychosocial impact rather than the actual presence of a discolored tooth. This is also corroborated in our binary logistic regression analysis with participants who claim self-perception of tooth discoloration showing four times odds of having higher psychosocial impact compared to those without such perception. The increased perception levels in the junior classes may perhaps be linked to their curriculum and how they perceive tooth discoloration, they may perceive discoloration as anything different from a completely white tooth, hence an exaggerated self-perception of discoloration amongst them.

Data analyzed from this study, appears to signify religion and ethnicity have major roles to play in the psychosocial impact of tooth discoloration. These factors in addition to sociocultural factors which was reported by Slade [17] as likely to be responsible for subtle differences seen in oral health impact profile have been sparsely investigated. Their roles in tooth discoloration may need to be explored in further investigations. This perhaps is a gap identified for future researchers to look into.

Our study is limited because of its cross-sectional design and it may be difficult to draw a causative inference as there could be a host of factors that are responsible for the psychosocial impact of tooth discoloration. Perhaps for future research, an experimental study design with greater internal validity will help to establish causation and hence greater inference and conclusions can be drawn. There should be caution in the interpretation of our findings as the study can only be generalized to adolescents within Ibadan North West Local Government.

The self-perception of tooth discoloration appears to have a greater tendency to cause psychosocial impact than the actual presence of tooth discoloration. Hence it is very important to influence how adolescents perceive their teeth appearance. This can be done by the government ensuring policies are put in place for adolescents to be taught proper oral health education, care, and promotion in schools by their teachers. Oral health care practitioners should also endeavor to carry out school-based oral health education programs and outreaches. Finally, when parents and adolescents visit dental clinics, this opportunity should be seized to educate them on oral health.

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