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FACTORS THAT INFLUENCE SELF-PERCEPTION OF SMILE ATTRACTIVENESS AMONG ADOLESCENTS

Izegboya O. Akpasa,[a] Tolulase A. Yemitan,[b] Babatunde O. Ogunbanjo,[b] Afolabi Oyapero[c]

Highlights

- Self-perceived dental aesthetics, severity of malocclusion and buccal corridor width are significant factors affecting self-perceived smile attractiveness
- Self-perceived dental aesthetics is a significant predictor of self-perceived smile aesthetics compared to severity of malocclusion or normative smile aesthetics

ABSTRACT

Objective: *This study explored the variables that determine self-perception of smile attractiveness in an adolescent sample population.*

Methods: *An analytical cross-sectional study conducted among 398 adolescents (184 males and 214 females) patients at a dental outpatient clinic in Lagos State, Nigeria between March and December 2019. The subjects were clinically assessed using the Dental Aesthetic Index. Photographs of their frontal posed smiles and intraoral frontal view with teeth in centric occlusion were taken for rating on a visual analog scale (VAS) for self-perception of smile attractiveness and dental aesthetics attractiveness, and objective smile analysis. Data were analyzed with ANOVA and Tukey's post-hoc tests to compare variables among groups based on their self-perceived smile attractiveness. Regression analysis was done with smile attractiveness as a dependent variable to determine predictors of smile attractiveness.*

Results: *Participants' mean age was 14.17 years (SD ± 2.74). Respondents who perceived their smile as unattractive significantly had more severe malocclusion ($p = 0.034$) and significantly perceived their dental aesthetics as unattractive ($p < 0.01$) compared to those who perceived their smile to be very attractive. Regression model showed a significant effect of self-perceived dental aesthetics attractiveness and buccal corridor ratio ($p < 0.05$) on smile attractiveness. The strongest predictor of self-perceived smile attractiveness was self-perceived dental aesthetics attractiveness.*

Conclusion: *Self-perception of dental aesthetics attractiveness is a strong predictor of smile attractiveness and should therefore be assessed during orthodontic pre-treatment assessment since this can influence patients' satisfaction with treatment results.*

Key Words: *Dental Aesthetics, Smile attractiveness, malocclusion, adolescent, Nigeria*

a Resident, Department of Child Dental Health, Lagos State University Teaching Hospital, Lagos, Nigeria.

b Senior Lecturer, Department of Child Dental Health, Faculty of Dentistry, Lagos State University College of Medicine, Lagos, Nigeria.

c Senior Lecturer, Department of Preventive Dentistry, Faculty of Dentistry, Lagos State University College of Medicine, Lagos, Nigeria.

Corresponding author: Dr Yemitan Tolulase, Senior Lecturer, Department of Child Dental Health, Lagos State University College of Medicine, Lagos, Nigeria.

Email: tolulasevemitan@vahoo.com

INTRODUCTION

Reasons for seeking orthodontic treatment may be functional or aesthetics, but many factors may influence an individual's perception of orthodontic treatment need. Self‑perceived dental attractiveness has been suggested to have a strong influence on the decision to seek orthodontic care. [1] Dentofacial attractiveness is a crucial component in total physical attractiveness.[2] Hence, patients' self-perception of their dentofacial attractiveness is a key motivational factor for seeking orthodontic evaluation; at times, aesthetics concerns superseded dental health.[3]

A major benefit of orthodontic treatment is correction of aesthetic component of malocclusion. Hence, the Dental Aesthetic Index (DAI), a cross-cultural index that focuses on socially defined standards for dental aesthetics was recommended by the World Health Organization (WHO) as a method of assessing dentofacial anomalies.[4]

Smile attractiveness has been related to several smile components such as the smile arc, gingival display, whiteness of the teeth and buccal corridor size.[5-7]

Few studies[8-10] have investigated the adolescents' perception of their smile aesthetics. Many orthodontic corrections commence during the adolescent period, when self-concept and interactions set a foundation for the individual's life.[11] Most adolescents are accompanied by adults who decides on their orthodontic treatment plans, which may not reflect the perceived needs of the adolescent. The paucity of studies on adolescent perception of smile attractiveness has therefore created a research gap which this study attempted to bridge.

The purpose of this study was to determine factors associated with self-perception of smile attractiveness. The specific aim of this study was to examine how self-perceived dental aesthetics attractiveness, severity of malocclusion, and normative smile aesthetics influenced self-perception of smile attractiveness among a sample of Nigerian adolescents.

MATERIALS AND METHODS

Study Design

Ethical approval was obtained from the Health Research and Ethics Committee of the institution for the study (LREC. 06/10/813). Written informed consent was taken from subjects 18 years and above as well as parents of the selected subjects below the age of 18 years who were willing to participate in the research. Written assent was similarly taken from the subjects below the age of consent of 18 years.

This study was designed as a cross-sectional study. The subjects were 10 – 19 years adolescents recruited from patients who visited a hospital outpatients' dental clinic between March and December 2019. The study was carried out in Lagos State, in the South-west geopolitical zone of Nigeria. Lagos has a heterogeneous population due to the diversity in the ethnic groups of its inhabitants. These patients include first time attendees to the oral diagnosis clinic, and patients referred to oral specialist clinics.

The sample size was calculated as n = 273, based on a prevalence rate of 23.1% dissatisfaction with malocclusion in a Nigerian population from a previous study.[12] To compensate for a 30% nonresponse rate, a total of 398 adolescents with permanent dentition, who were willing to participate and gave consent were randomly selected using simple random sampling technique. Adolescents who have undergone orthodontic treatment or any major maxillofacial surgical/ reconstructive procedure; those with mixed dentition; those who have facial asymmetry or deformities and those with history of trauma to their anterior teeth were excluded.

Data Collection

Determination of severity of malocclusion

Study participants were examined on a functional dental chair while their orthodontic treatment need was determined using the DAI[4] **(Table 1).** The participants were categorized into four malocclusion severity levels based on their DAI scores: normal or minimal malocclusion (DAI score of ≤25), definite malocclusion (DAI score of 26 – 30), severe malocclusion (DAI score of 31 – 35), and handicapping malocclusion (DAI score >35).

Table 1: Components of Dental Aesthetic Index

Components of DAI	Weight
Number of missing incisor, canine or premolar teeth in maxillary and mandibular arches	6
Crowding in the incisal segments (number of segments crowded)	1
0 = No segment crowded, 1= One segment crowded, 2= Two segments crowded	
Spacing in the incisal segments (number of segments spaced)	1
0 = No segment spaced, 1= One segment spaced, 2= Two segments spaced	
Midline diastema (in millimetres)	3
Largest anterior irregularity on the maxilla in millimetres	1
Largest anterior irregularity on the mandible in millimetres	1
Anterior maxillary overjet in millimetres	2
Anterior mandibular overjet in millimetres	4
Vertical anterior open bite in millimetres	4
Antero-posterior molar relation, largest deviation from normal.	3
0 = normal, 1=1/2 cusp deviation, 2 – one full cusp deviation	
Constant	13
Total	DAI score

Smile and Intraoral Photographs

Using the standardized photography method of Claman et al.[13] with equal distance from the outer canthus of the eye to hairline on each side, posed smile photographs of the participants were taken at the same distance (1.7m) from a Nikon D 40X D-SLR camera with a standard 18-55mm lens mounted on a tripod. The frontal intra-oral view of teeth in

centric occlusion was also taken with subjects sitting on the dental chair at approximately 135^0 to the floor with the cheeks retracted.

The posed smile photograph and the intra-oral photograph of all study participants were cropped and resized to 5 by 7-inch frames (CorelDRAW Graphics Suite (2016), Corel Corporation., Ottawa, Canada). The upper vertical limit was just below the soft tissue pronasale and the lower limit was the soft tissue pogonium. The lateral limits were lateral to the outer commissures of the lips. The photographs were printed (HP Color LaserJet Pro M254dw, USA) on A4 all-purpose premium paper (PaperOne™ Singapore) and attached to the questionnaires of individual subjects to enable them assess self-perception of their smile attractiveness and their dental aesthetics attractiveness.

Questionnaire

A questionnaire **(Appendix 1)** was administered having 2 sections, namely demographics and the visual analogue scale (VAS) which assessed the edited photographs for smile and dental aesthetics attractiveness.[14,15]

Appendix 1

The validity and reliability of VAS in measuring the role of psychosocial exposures in the development and course of diseases was investigated and compared with that of a validated Likert scale in a previous study.[16] Significant moderate to strong correlation was found between VAS and Likert indices, suggesting that both scale types are comparable with regard to reliability.

The VAS assessment involved a 100mm line with a minimum score of 0 at the beginning represented the “least attractive” and a maximum score of 10 at the end the “most attractive” at 100 mm. Each participant was given their edited posed smile photograph and intra-oral photograph for self-assessment of their smile attractiveness and dental aesthetics attractiveness respectively by manually placing a mark on the VAS scale to indicate their

answer (Appendix 1). The distance between the participant's mark and the zero-anchor point was measured in millimeters and served as an estimate of the esthetic value placed on the image. These distances were measured by using a millimetre ruler and graded by a range of scores from 0–10. A VAS assessment score of <5 was taken as unattractive, while a score of 5 – 6.9 and ≥7 was taken as attractive and very attractive respectively.[14,15]

Objective smile assessment

Using CorelDRAW imaging software, reference points[17] were identified on the edited photographs **(Figure 1)** and measured. The distance between the distal aspects of teeth 11 and 21 was used to determine the magnification ratio.[18]

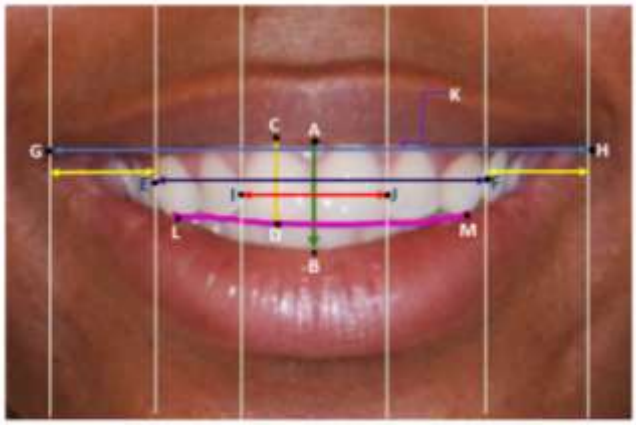

Figure 1. Reference Points measured on a Posed Smile. A: Midmost point on the lower curvature of the upper lip; B: Midmost point on the upper curvature of the lower lip; C: Point where the lower curvature of upper lip meets the long axis of the maxillary right incisor; D: Most incisal point of the maxillary right central incisor; E: Point on the most lateral surface visible on the right maxillary canine; F: Point on the most lateral surface visible on the left maxillary canine; G:Right outer commissure; H: Left outer commissure; I: Distal aspect of the right central incisor; J: Distal aspect of the left central incisor; K: Gingival display; L: Tip of maxillary right canine; M: Tip of maxillary left canine.

Definition of points measured:

1. Smile arc: The curvature of a line drawn through the incisal edges of maxillary incisors and canines in relation to the curvature of the lower lip when smiling (Line L-M). It was classified as consonant smile arc if the line drawn was parallel to the curvature of the lower lip; flat smile arc if the line drawn was straight compared to the curvature of the lower lip; and reverse smile arc if the line drawn was an inverted curve when compared to the curvature of the lower lip.

2. Buccal corridor ratio: The ratio of intercanine width (E-F) to the inter-commissural smile width (G-H).

3. Smile line: based on the extent of vertical display of the maxillary right incisor (C–D), and the extent of gingival visibility when smiling (Point K), smiles lines of the subjects would be classified as gummy smile

(subject displays more than 4mm of gingiva when smiling), high smile line (subject displays the whole length of the central incisors and a distinct gingival band when smiling), average smile line (subject displays ≥ 75% of the length of central incisors and the interdental papillae when smiling) and low smile line (subjects displays <75% of the length of central incisors while smiling). [19]

4. Smile index: It indicates the display area of the subject while smiling and defined as inter-commissural (smile) width (G-H) divided by inter-labial gap (A–B).

Measurement Reliability

The DAI scores, VAS scores and smile dimension measurements were repeated for twenty study participants two weeks after the initial measurements by the same examiner**.** Pearson's coefficient analysis was utilized to determine intra-examiner reliability.

Data Analysis

Data was analyzed with the IBM Statistical Package for Social Sciences (SPSS) for Windows Version 23.0. (IBM Corp., Armonk, NY, USA). Numeric data with normal distribution were presented as means and standard deviations. Categorical data was displayed using frequencies and percentages. Pearson's Chi square test analyzed differences between subgroups of categorical variables. Student t-test compared mean between two groups, while analysis of variance (ANOVA) compared more than two means with Tukey's post hoc tests. Regression analysis was done with smile attractiveness as a dependent variable to determine predictors of smile attractiveness. Statistical significance was put at a 5% level and a Confidence Interval of 95%.

RESULTS

The results of intra-examiner reliability by comparisons of scores from repeated measurements demonstrated a high level of repeatability of these measurements **(Table 2).**

Overall, 398 respondents (53.8% females and 46.2% males), aged 10 – 19 years (mean age: 14.17 ± 2.74) were included. Smile analysis showed that the most common smile line was the low smile line, followed by the average smile line **(Table 3).**

Bivariate tests using one-way ANOVA showed a statistically significant difference in respondents' self-perceived dental aesthetics and Dental Aesthetic Index score when compared based on their self-perception of smile attractiveness **(Table 4).** Tukey's post hoc tests revealed respondents who perceived their smile as unattractive significantly had more severe malocclusion (p=0.034) and rated their dental aesthetics as unattractive (p=0.000) compared to those who perceived their smile to be very attractive. The results however found no statistically significant association between normative smile aesthetics and self-perceived smile attractiveness (p > 0.05).

The regression analysis showed that self-perceived smile attractiveness presented a significant

association to the predictor variables (p < 0.001). The variables used in the model predicted 20.1% (Adjusted R^2 = 0.201) of the variability in self-perceived smile

attractiveness, indicating that participants' answers were also influenced by factors other than those investigated.

The regression model showed a significant effect of self-perceived dental aesthetics attractiveness (Unstandardized B = 0.388; $p < 0.001$) and buccal corridor ratio (Unstandardized B = 1.414; $p = 0.026$) on self-perceived smile attractiveness, while sex, age and all other examined factors were not significantly associated to the primary outcome **(Table 5).**

When effects of individual variable on smile attractiveness was examined, the only variable that appeared to have a significant effect on the primary outcome was self-perceived dental aesthetics **(Table 6).**

Table 2: Evaluation of intra-examiner reliability using Pearson's coefficient

Variables	Correlation coefficient (r)
Number of missing incisor, canine or premolar teeth in maxillary and mandibular arches	0.95
Crowding in the incisal segments	0.97
Spacing in the incisal segments	0.98
Midline diastema (in millimetres)	0.94
Largest anterior irregularity on the maxilla in millimetres	0.94
Largest anterior irregularity on the mandible in millimetres	0.94
Anterior maxillary overjet in millimetres	0.96
Anterior mandibular overjet in millimetres	0.95
Vertical anterior open bite in millimetres	0.97
Antero-posterior molar relationship	0.95
VAS smile aesthetics	0.80
VAS dental aesthetics	0.80
Inciso-gingival display	0.96
Buccal corridor	0.93
Inter commissural width	0.95
Inter labial gap	0.94
Inter incisal distance	0.96

Table 3. Sociodemographic characteristics of participants

Variable	Categories	N	%
Gender	Male	184	46.2
	Female	214	53.8
Dental Aesthetic Index score	No treatment need	239	60.1
	Elective	89	22.4
	Highly desirable	34	8.5
	Treatment mandatory	36	9.0
Smile attractiveness	Unattractive	86	21.6
	Attractive	84	21.1
	Very attractive	228	57.3
Dental aesthetics attractiveness	Unattractive	138	34.7
	Attractive	84	21.1
	Very attractive	176	44.2
Smile arc	Consonant	197	49.5
	Flat	147	36.9
	Non consonant	54	13.6
Smile line	Average	160	40.2
	Gummy	14	3.5
	High	54	13.6
	Low	170	42.7
Buccal corridor ratio†		0.59 ± 0.19	
Smile index†		6.51 ± 4.34	
Age†		14.17 ± 2.74	

† Displayed as Mean (Standard Deviation)

Table 4. Association of study variables based on respondents' self-perceived smile attractiveness

Variable	Self-perceived smile attractiveness				
	Unattractive N(%)	Attractive N(%)	Very attractive N(%)	Total N(%)	P-value
Smile arc					
Consonant	35(40.7)	38 (45.2)	124(54.4)	197(49.5)	0.222
Flat	36 (41.9)	34 (40.5)	77(33.8)	147 (30.4)	
Non consonant	15 (17.4)	12 (14.3)	27(11.8)	54(13.6)	
Smile line					
Average	29 (33.7)	37 (44.1)	94(41.2)	160(40.2)	0.429
Gummy	2 (2.3)	2 (2.4)	10 (4.4)	14(3.5)	
High	11 (12.8)	12(14.3)	31(13.6)	54(13.6)	
Low	44 (51.2)	33 (39.3)	93(40.8)	170 (42.7)	
Gender					
Male	40(46.5)	39(46.4)	105(46.1)	184(46.2)	0.997
Female	46(53.5)	45(53.6)	123(53.9)	214(53.8)	
Age‡	14.38 (2.60)	14.61 (2.77)	13.93 (2.77)	14.17 (2.74)	0.110
Dental Aesthetic Index score‡	26.39 (8.03)	25.64 (6.36)	24.16 (6.93)	24.95 (7.12)	**0.028***
Self-perceived dental aesthetics‡	4.12 (2.54)	5.33 (2.17)	6.83 (2.65)	5.93 (2.76)	**0.000*****
Buccal corridor ratio‡	0.57 (0.23)	0.58 (0.21)	0.61 (0.16)	0.59 (0.19)	0.309
Smile index‡	6.11 (2.02)	6.16 (1.98)	6.79 (5.46)	6.51 (4.34)	0.325

$F(10, 782) = 8.07$, $p = .000$; Wilk's $A = 0.822$, partial $\eta^2 = 0.09$

‡ Displayed as Mean (standard deviation)

*** significant at $p < .001$ with ANOVA tests

* significant at $p < .05$ with ANOVA tests

Table 5: Regression of self-perceived attractiveness on sex, age, smile dimensions, malocclusion severity and perceived dental aesthetics attractiveness

Dependent variable	Parameter	*B*	*SE*	*95% CI*	*p value*
Self-perceived smile attractiveness	Age	-0.081	0.044	(-0.167,0.006)	0.067
	Gender	0.282	0.233	(-0.176,0.740)	0.227
	Dental Aesthetic Index score	-0.011	0.017	(-0.044,0.022)	0.525
	Self-perceived dental aesthetics	0.388	0.044	(0.302,0.473)	**0.000*****
	Buccal corridor ratio	1.414	0.634	(0.167,2.661)	**0.026***
	Smile index	0.029	0.027	(-0.023,0.082)	0.275

$F(6, 391) = 17.686$, $p < .0005$, $R^2 = 0.213$

SE = Standard error

CI = Confidence interval

*** significant at p < .001

* significant at p < .05

Table 6. Regression coefficients of predictor variables, displaying their individual effect on self-perceived smile attractiveness

Dependent variable	Predictors	Standardized coefficients Beta	p-value
Self-perceived smile attractiveness	Self-perceived dental aesthetics	0.442	**0.000*** **
	Age	-0.052	0.248
	Gender	0.047	0.300
	Dental Aesthetic Index score	-0.034	0.460
	Buccal corridor ratio	0.083	0.067
	Smile index	0.040	0.379

*** significant at P < .001

DISCUSSION

In orthodontic treatment planning, it is important to identify factors that affect self-perceived smile attractiveness to set treatment goals that meet patients' expectations. The present study explored how self-perceived dental aesthetics attractiveness, severity of malocclusion, and normative smile aesthetics influenced self-perception of smile attractiveness among a sample of Nigerian adolescents.

The results showed that those who perceived their smiles as unattractive significantly had more severe malocclusion (Table 4). These results agree with prior research findings where people with normal occlusion were perceived as more attractive compared with those with malocclusion.[20,21] Self-perceived aesthetics was also found to be associated with malocclusion severity levels among Brazilian adolescents.[22] The existence of cultural and individual variations in acceptance of some occlusal irregularities, such as diastemas,[23,24] suggests a need for comparison of results from different populations to identify cultural differences in the impact of occlusal irregularities on perceived smile attractiveness.

The present study showed that those who perceived their smile as unattractive significantly rated their dental aesthetics as unattractive compared to those who perceived their smile to be very attractive (Table 4). Furthermore, based on the perception of the respondents in the present study, regression analysis found that the only individual variable that appeared to have a significant effect on self-perceived smile attractiveness was self-perceived dental aesthetics (Table 6).

Perception of dental appearance, whether self-rated or rated by other individuals is therefore of major importance in orthodontics. It is influenced by societal aesthetic norms, psychological factors and personal preferences.[25] Minor occlusal irregularities tolerated in other individuals may result in serious concern when self-perceived. Sometimes, professional opinions regarding dental aesthetics may not coincide with perception of patients, even as it was suggested that an ideal post-orthodontic treatment occlusion does not guarantee the achievement of smile attractiveness.[26,27]

While some authors did not consider the buccal corridor as a contributing factor to an attractive smile,[28] others reported that the smaller the buccal corridor, the more attractive the smile.[29] Regression analysis found that self-perceived smile attractiveness in the present study could be predicted by buccal corridor ratio (Table 5). This implied that changes in buccal corridor ratio can be perceived to have a significant effect on perception of attractiveness of smile aesthetics and satisfaction with treatment outcome at the end of orthodontic treatment.

The variables utilized in this study accounted for 19.3% (Adjusted R^2 = 0.193) of the variation in self-perceived smile attractiveness, suggesting that other unexamined variables could have affected the responses of the participants such as tooth colour.[6]

Because this study population was limited to a group of adolescents, to control for the potential confounding effect of age,[30] the findings may not represent the entire Country. Another limitation is that anatomical landmark variability could be a possible source of error in this study. However, this confounder is not expected to have influenced our results because of the high standardization of image acquisition used in data collection and large sample size.

CONCLUSION

In adolescents, self-perceived dental aesthetics, severity of malocclusion and buccal corridor width are significant factors affecting self-perceived smile attractiveness. In the present sample population, self-perception of dental aesthetics is a greater predictor of smile attractiveness among Nigerian adolescents than normative smile aesthetics or severity of malocclusion.

These findings provide important diagnostic information to orthodontists, orthognathic surgeons and other clinicians who work to improve facial, dental and smile aesthetics.

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Conflict of interest: There is no relationship with any party that may present a potential conflict of interest.

Informed Consent: Written informed consent was taken from subjects 18 years and above as well as parents of the selected subjects below the age of 18 years who were willing to participate in the research. Written assent was similarly taken from the subjects below the age of consent of 18 years.

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