



Normative Orthodontic Treatment Need of Nigerian Adolescents – A Comparative Study of Three Major Ethnic Groups

S. S. Etim^{1*}, E. A. Aikins¹ and C. O. Onyiaso¹

¹*Department of Child Dental Health, Faculty of Dentistry, College of Health Sciences, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author SSE designed the study, managed literature searches, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EAA and COO managed the analysis of the study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2020/v32i330385

Editor(s):

- (1) Dr. Joao Paulo Schwartz, Universidade Estadual Paulista (UNESP-FOAr), Brazil.
- (2) Kate S. Collison, King Faisal Specialist Hospital & Research Centre, Saudi Arabia.
- (3) Nurhan Cucer, Erciyes University, Turkey.

Reviewers:

- (1) Sanjeev V. Jakati, DR. N.T.R University of Health Sciences, India.
- (2) Cristina Grippaudo, Università Cattolica del Sacro Cuore, Italy.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/54898>

Original Research Article

Received 05 January 2020

Accepted 11 March 2020

Published 19 March 2020

ABSTRACT

Objective: This study was carried out to assess and compare the normative orthodontic treatment need of adolescents aged 12 to 16 years from the three major ethnic groups in Nigeria.

Methods: The study population comprised one thousand, four hundred and forty-nine (1449) adolescents selected from nine public schools within nine Local Government Areas from three (3) selected states (Lagos, Kano, Imo) in Nigeria. Randomization based on multistage sampling technique was used to determine the selected participants. Consent and assent forms were duly completed and signed by parents and participants respectively. Participants' parents were from the same ethnic group. Oral examination of the participants was done and their normative treatment need assessed following the standard protocols of Index of Complexity, Outcome and Need. (ICON) Data collected were analyzed using Statistical Package for Social Science version 20.0. Descriptive, as well as parametric (ANOVA) and non-parametric (Chi-square) statistical analyses were conducted.

*Corresponding author: E-mail: udypride@yahoo.ca;

Results: Normative (objective) orthodontic treatment need was observed in 27.7%, 31.5% and 42.8% of Igbo, Hausa and Yoruba adolescents, respectively. The mean ICON scores recorded were for Hausa, 33.0 ± 16.1 (SD), 32.1 ± 16.6 (SD) for Igbo and 34.8 ± 16.2 (SD) for the Yoruba, with a statistically significant difference noted among the groups. The mean scores were 33.9 ± 16.2 for males and 32.8 ± 16.4 for females while the combined population mean was 33.4 ± 16.3 . The males had more orthodontic treatment need than the females in the combined population.

Conclusion: Yoruba adolescents statistically had the greatest normative orthodontic treatment need while Igbo adolescents had the least among the three major Nigerian tribes.

Keywords: Normative; orthodontic treatment need; index of complexity; outcome and need; ethnic groups; Nigeria.

1. INTRODUCTION

Orthodontic treatment need can be defined as “the degree to which a person needs orthodontic treatment because of certain features of his or her malocclusion, functional, or dental health, the aesthetic impairment it occasions, and its negative psychological and social repercussions [1].” Orthodontic treatment needs of a group of people, if properly assessed can help in the planning of the type of orthodontic treatment to administer to them. It can be normative or perceived. Normative need is defined as need that is professionally determined by means of set criteria while perceived need is what people think they need or feel their needs to be [1]. This study was focused on normative orthodontic treatment need.

Adolescence is the period of life between ages 10 and 19. It is characterized by marked psychological changes, development of sexual feelings, efforts toward the construction of identity and a progression from concrete to abstract thoughts [2]. It is generally regarded as an emotionally intense and often a stress prone period [2] when teenagers often experience various mood swings [3]. Adolescence is also the period when the canines and premolars erupt and most orthodontic problems become obvious [4]. These changes make adolescents get concerned about their appearance even as they become more easily affected by peer influence. It is therefore, necessary to determine the normative orthodontic treatment need of this age bracket so as not only to adequately plan the necessary treatments that might be needed for them, but equally to counsel them professionally.

Malocclusion is an abnormal occlusion in which teeth are not in a normal position in relation to adjacent teeth in the same jaw and/or the opposing teeth when the jaws are closed [5]. Malocclusion can play an important role in social

acceptance and interactions for aesthetic reasons and can also result in functional limitations in more severe cases [5]. Aetiology of malocclusion is multifactorial, genetics being one of them. It is known that different genes are responsible for jaw size and tooth size. In other words, jaw size and tooth size can be inherited independently as seen in numerous studies like those of Gass et al. [6], Johannsdottir et al. [7], Cassidy et al. [8] and Manfredi et al. [9]. These authors examined how genetic variations contributed to either or both occlusal and skeletal variations among family members. The general morphology of craniofacial bones and teeth are largely genetically determined, although clear variation is partly attributable to environmental factors as seen in studies by Kraus and Lufkin [10] as well as Thesleff [11] and Klingenberg et al. [12].

In the past, there were no universally accepted measures to assess the need for orthodontic treatment. Therefore, various occlusal indices were used. Some of the indices from a normative or orthodontic specialists viewpoint include; Handicapping Labio-lingual Deviation Index [13], Salzmann’s Handicapping Malocclusion Assessment Record [14], Orthodontic Treatment Priority Index [15], Summer’s Occlusal Index [16], The Indication Index [17], Index of Orthodontic Treatment Need [18] (IOTN), Peer Assessment Rating (PAR) index [19], Dental Aesthetic Index [20] (DAI), Norwegian Orthodontic Treatment Index [21] (NOTI). These were developed and used for different national health care systems but not all gained international recognition.

In 1998, the Index of Complexity, Outcome and Need (ICON) [22] was developed by an international panel of 97 orthodontists from 8 European countries and the United States. The index is based on international orthodontic opinion and was proposed to assess treatment

need, complexity and outcome as a single assessment method. It comprises five components: Aesthetic assessment/component, upper arch crowding /spacing, crossbite, incisor open bite/overbite/anterior vertical relationship and buccal segment antero-posterior relationship. The components are measured, multiplied by their respective weights and summed up to give an overall score. The ICON cut-off score for orthodontic treatment need is a score of 43 and greater. Since it is known that ethnicity affects the perception of malocclusion then it could also determine to some extent the orthodontic treatment need [22]. Similarly, geographic location can influence an individuals' need for orthodontic treatment [23,24]. In North West London among the minority ethnic groups and white population, there was no significant variation in the professional orthodontic treatment need between the different ethnic groups [25]. On the contrary, a study [26] was conducted among school aged children of various ethnic groups residing in Dubai comparing South Asian group to Middle East group. The South Asian countries included India, Pakistan, Philippines and Bangladesh while Middle East countries included Egypt and UAE, Yemen, Syria, Iran, Jordan, Iraq, Palestine and Lebanon. The average IOTN grade for South Asia was significantly higher than the Middle East grade. This also was shown in the IOTN grade 4 and 5 combined together where the percentage was found to be 17.9% in the South Asian population and 9.1% for the Middle East population. This showed significant variation in the orthodontic need of the various ethnic backgrounds.

Although there are some studies [27,28,29,30] from Nigeria on orthodontic treatment, none has specifically assessed and compared objective orthodontic treatment needs of potential orthodontic patients from the three major ethnic groups in the country, hence, the need for this study. It was hypothesized that there would be no statistically significant difference, in the professionally assessed orthodontic treatment need among adolescents from the three major ethnic groups in Nigeria with each ethnic group claiming distinct ancestral origin.

2. MATERIALS AND METHODS

This was a comparative, descriptive cross-sectional study carried out among 12-16 years old adolescents from the three major ethnic groups in Nigeria consisting of Igbo, Yoruba and

Hausa. Nigeria has over 400 ethnic groups of which these three are considered the major ethnic groups [31]. The country is made up of six geopolitical zones comprising South-South, South-West, South-East, North-Central, North-West and North-East. The number of participants was obtained based on the proportion of the three ethnic groups from the 2006 national census projected to 2016. Hausa tribe is found chiefly in North-Western Nigeria and adjacent Southern Niger. According to Hausa tradition, the people originated from the line of an exiled prince named Bayajida [32]. The Yoruba ethnic group occupies the South-Western part of Nigeria. They account for about 20% of the population of the country [31]. Igbo ethnic group occupy majorly the South-Eastern region of Nigeria.

A multistage sampling technique was employed in this study. At the first stage, one state each from South-Eastern Zone (Imo), South-Western Zone (Lagos) and North-Western Zones (Kano) of Nigeria was randomly selected using a table of random numbers (Fig. 1).

The states in each of the three geopolitical zones served as the sampling frame. In the second stage, nine local Government areas, three from each of the three states were randomly selected through balloting. The local Government areas in the selected states served as the sampling frame. In the third stage, a list of schools in each of the selected Local government areas was obtained from each State Ministry of Education. One school was then randomly selected from the list of registered schools from each of three Local Government Areas using the table of random numbers. The sampling frame here was the list of Government registered schools. The classes of the students were stratified based on the ages of the students, which was 12 – 16 years from school records. The stratification allowed equal chance of a participant to be selected. The class register was checked to confirm the tribe of the students. For those that adequate information was not provided since mothers' tribe were not stated apart from state of origin, the students were asked to write their parents' tribes and from those eligible, a list was made and the participants were randomly selected using table of random numbers. These were to ensure that participants were selected based on geographic locations and children whose parents were from the same ethnic group.

Ethical clearance was sought and obtained from the Ethical Committee of a tertiary health

institution (UPTH/ADM/90/S.11/VOL.X/798). Permission was sought and obtained from the administrators of the schools that were involved in the study. Informed consent was obtained from the parents of the participants while assent was obtained from the participants. Consent was also sought from the administrators of the nine schools that were involved in the study before any contact with the students. The classes that had 12- 16 years students were confirmed from the records from the school. In each of the classes, the register was used and using table of random numbers, the participants for the study were chosen and those that both parents were not from same tribe, were excluded and the next suitable name used. On obtaining duly filled consent forms by the parents of the participants, assent from the students, the examination of eligible participants was carried out. This was done under natural light. The objective orthodontic treatment need was assessed by the lead researcher who was duly calibrated on the

use of ICON and standard protocol on the use of ICON was strictly adhered to.

2.1 Intra-examiner Reliability Test

To ensure intra-examiner reliability during the examination of the participants, 10% of the sample subjects were randomly re-examined by the lead researcher after 4 weeks of initial assessment. The two examinations were analyzed for reliability using Kronbach alpha correlation test and the two results had good correlation ($r = 0.73$).

2.2 Statistical Analysis

Statistical Package for Social Science Version (SPSS) 20 was used to analyze the final data. Descriptive, parametric (ANOVA), non-parametric (Chi-square) statistics were used in the analysis of the data and testing of the null hypothesis. Test for significance was set at a p-value of 0.05.



Fig. 1. Locations of the study

3. RESULTS

3.1 Socio-Demographic Data of Participants

A total of one thousand, four hundred and forty-nine (1449) adolescents were enrolled into this study comprising 808 (55.76%) males and 641(44.24%) females with a mean age of 14.20±1.37(SD) years. Six hundred and twelve (42.24%) were Hausa (male = 50.2%, female = 49.8%) with a mean age of 14.2±1.2 (SD) years. Five hundred and sixteen (35.16%) were Yoruba (male = 67.8%, female = 32.2%) with a mean age of 14.1±1.5 (SD) years and 321 (22.15%) were Igbo (male = 47.0%, female = 32.2%) with a mean age of 14.1±1.3 (SD) years. (Table 1).

3.2 Normative Orthodontic Treatment Need of the Adolescents in the Three Tribes

The overall prevalence of orthodontic treatment need in the combined study population was found to be 35% (Fig. 2). For Hausa, 193(31.5%) of them were found to have need for orthodontic treatment and 419 (68.5%) had no need (Table 2). Two hundred and twenty-one (42.8%) of Yoruba participants had a need for orthodontic treatment, 295 (57.2%) had no need for orthodontic treatment (Table 2). Eighty-nine (27.7%) of the Igbo adolescents were found to have a need for orthodontic treatment, 232 (72.3%) had no need. The orthodontic treatment need assessed using ICON in Igbo, Hausa and Yoruba adolescents was 27.7%, 31.5% and 42.8% respectively (Table 2).

Table 1. Socio-demographic data of participants (n = 1449)

Age (years)	Hausa n (%)		Igbo n (%)		Yoruba n (%)	
	Male	Female	Male	Female	Male	Female
12	41 (13.4)	8 (2.6)	15 (9.9)	16 (9.4)	41 (11.7)	27 (16.3)
13	81 (26.4)	44 (14.4)	29 (19.2)	30 (17.6)	78 (22.3)	23 (13.9)
14	92 (30.0)	72 (23.6)	45 (29.8)	60 (35.3)	86 (24.6)	36 (21.9)
15	57 (18.6)	104 (34.1)	32 (21.2)	43 (25.3)	84 (24.0)	54 (32.5)
16	36 (11.7)	77 (25.2)	30 (19.9)	21 (12.4)	61 (17.4)	26 (15.7)
Total	307(50.2)	305(49.8)	151(47.0)	170 (53.0)	350(67.8)	166(32.2)
Mean age	14.2 ±1.2 (SD)		14.1±1.3 (SD)		14.1±1.5 (SD)	

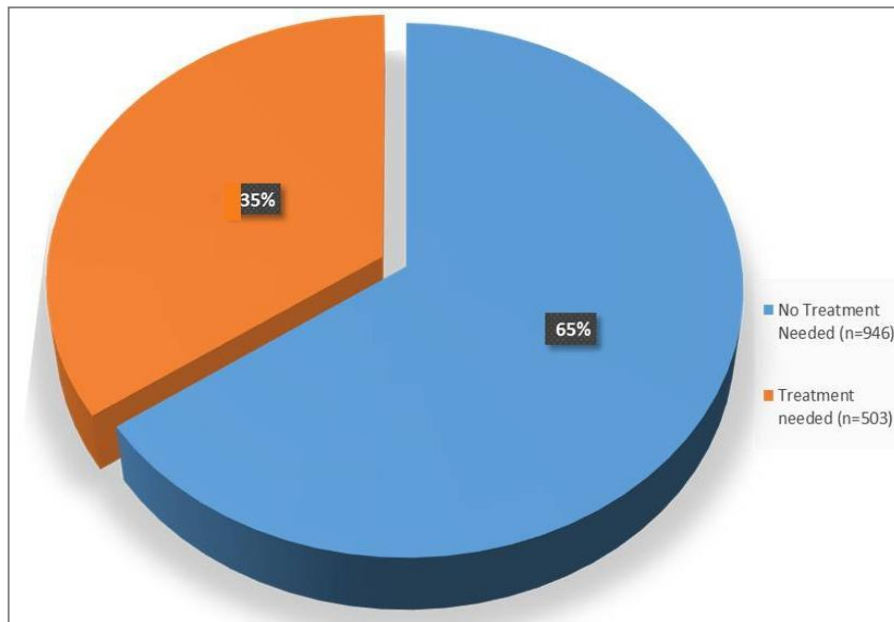


Fig. 2. Prevalence of orthodontic treatment need in all subjects

Table 2. Distribution of orthodontic treatment needs in the three ethnic groups in Nigeria

Objective treatment need	Hausa N (%)	Igbo N (%)	Yoruba N (%)	Chi-square (p-value)
No	419 (68.5)	232 (72.3)	295 (57.2)	21.97 (0.0001)
Yes	193 (31.5)	89 (27.7)	221 (42.8)	
Total	612 (100.00)	321 (100.00)	516 (100.00)	

3.3 Age and Its Relationship with Normative Orthodontic Treatment Need

Among the 12 year old adolescents, those from the Yoruba tribe had the highest orthodontic treatment need with 38.2%, followed by 30.6% and 16.1% for Hausa and Igbo, respectively (Table 3).

For the 13 year old adolescents, their orthodontic treatment need was 33.7%, 30.4% and 20.3% for Yoruba, Hausa and Igbo adolescents, respectively whilst that for the 14 year old adolescents, in the three major ethnic groups

was 36.1%, 27.4% and 21.9% for Yoruba, Hausa and Igbo respectively (Table 3).

Among the 15 year old adolescents, their orthodontic treatment need was 28.9%, 22.4%, 13.3% for Yoruba, Hausa and Igbo, respectively, and for the 16 year old adolescents, 33.3%, 21.6% and 21.4% for Yoruba, Igbo and Hausa, respectively (Table 3).

Generally, Hausa tribe followed Yoruba in each of the age categories except among the 16 years old where Igbo adolescents was next to Yoruba and the Hausa adolescents, the least (Table 3).

Table 3. Orthodontic treatment need among the across the tribes

Age (Years)	Objective treatment need	Hausa	Igbo	Yoruba	Chi-square (p-value)
12	No need	34(69.4)	26(83.9)	42(61.8)	4.86 (0.0878)
	Need	15 (30.6)	5 (16.1)	26 (38.2)	
	Total	49 (100.0)	31 (100.0)	68 (100.0)	
13	No need	87 (69.6)	47 (79.7)	67 (66.4)	3.27 (0.1947)
	Need	38 (30.4)	12 (20.3)	34 (33.6)	
	Total	125 (100.0)	59 (100.0)	101 (100.0)	
14	No need	119 (72.6)	82 (78.1)	78 (63.9)	3.27 (0.1947)
	Need	45 (27.4)	23 (21.9)	44 (36.1)	
	Total	164 (100.0)	105 (100.0)	122 (100.0)	
15	No need	125 (77.6)	65 (86.7)	98 (71.1)	6.78(0.0336)
	Need	36 (22.4)	10 (13.3)	40 (28.9)	
	Total	161 (100.0)	75(100.0)	1,138(100.0)	
16	No need	89 (78.8)	40 (78.4)	58 (66.7)	4.31 (0.1162)
	Need	24 (21.2)	11 (21.6)	29 (33.3)	
	Total	113 (100.0)	51 (100.0)	87 (100.0)	

Table 4. Relationship of gender and orthodontic treatment need across the three major ethnic groups in Nigeria

Objective treatment need	Hausa		Igbo		Yoruba	
	Male	Female	Male	Female	Male	Female
No	200 (65.1)	219 (71.8)	108 (71.5)	124 (72.94)	210 (60.00)	85 (51.2)
Yes	107 (34.9)	86 (28.2)	43 (28.5)	46 (27.06)	140 (40.00)	81 (48.8)
Total	307 (100.0)	305(100.0)	151(100.0)	170 (100.0)	350 (100.0)	166(100.0)
Chi-square (p-value)	3.14 (0.076)		0.08 (0.777)		3.55 (0.059)	

3.4 Gender and Orthodontic Treatment Need

Thirty (17.7%) female adolescents had need for orthodontic treatment and 140 (82.3%) had no need. One hundred and twenty (79.5%) male adolescents were found not to have need for orthodontic treatment while 31 (20.5%) had a need for orthodontic treatment. Yoruba male adolescents had the highest (125; 35.7%) orthodontic treatment need, followed by Hausa (87, 28.3%) and then, Igbo (31, 20.5%). Also, Yoruba female adolescents had the highest, with 48 (28.9%) followed by Hausa and Igbo female adolescents with 71 (23.3%) and 30 (17.7%), respectively (Table 4).

4. DISCUSSION

This study involving the three major ethnic groups in Nigeria, has provided useful information on the association between ethnicity and orthodontic treatment need among adolescents in these ethnic groups.

The prevalence of 35% for normative orthodontic treatment needs among the entire population studied is comparable to previous studies carried out among adolescents in South- South [27] and Western Nigeria [28] where the figures were 38.16%, 38%, respectively. It was also comparable to studies carried out in Asia [33,34] and Europe [35] where the prevalence of the orthodontic treatment needs of the adolescents ranged from 33.3% to 38.2%. This may be due to the fact that the sample populations in these studies were also adolescents with similar age ranges. However, school-based studies [29,36] carried out among adolescents in other Southern States of Nigeria as well as Brazil [37], Canada [38] and Europe [39,40,41] had different results. This difference in the finding could be due to the fact that specific tribes were used as inclusion criteria in this study.

In this study, the orthodontic treatment needs among the three ethnic groups studied varied with age. Twelve-year old participants had the highest normative orthodontic treatment need among Hausa and Yoruba extraction, whilst the 14-year-olds had the highest among the Igbo extraction. Fifteen-year old adolescents were found to have least normative orthodontic treatment need among Yoruba and Igbo extractions whilst 16-year-olds had the least for the Hausa tribe.

Interestingly, in this study, the younger adolescents (12 and 13-year-olds) had highest normative orthodontic treatment need in both Yoruba and Hausa tribes respectively, except in the Igbo tribe where the trend was different as the older (14 and 16-year-olds) adolescents had the highest normative orthodontic treatment need.

The reason for the difference in only Igbo tribe could not really be explained. However, the findings in Yoruba and Hausa tribes were similar to European studies [42,43] where the younger adolescents had more orthodontic treatment need than the older ones. This finding was in contrast to a Latvian study [44] where the 35-44 age group had a lower orthodontic treatment need than 12-13 and 18 years that were studied. This could be due to a wider age range involved in that study. The finding in Igbo adolescents was however similar to a Malaysian study [45] where the 16-year old adolescents had more orthodontic treatment need than the 12-year old participants. The findings in this study may suggest that there is no consistent significant relationship between age and orthodontic treatment need, since an individual of any age, could be found within any category of orthodontic treatment need.

Among the Igbo and Hausa participants, the male adolescents needed orthodontic treatment more than the females, whilst female Yoruba adolescents had a greater orthodontic treatment need when assessed professionally than their male counterparts. There was a statistically significant difference between the male and female adolescents who participated in the study generally. ($p= 0.004$). This finding was similar to previous Nigerian [27] and European [46] studies where ICON was also used as the assessment tool and other studies in Nigeria [47,48] Asia [49] and Europe [50,51] in which DAI and IOTN were used. The finding was however, in contrast with Asian [52,53,54] and Brazilian [55] studies where there was no difference in the orthodontic treatment need among male and female participants. However, no particular reason could be attributed to this. This study revealed a marked variation between orthodontic treatment need and gender.

5. CONCLUSION

This study has affirmed the influence of ethnicity on the normative orthodontic treatment need of adolescent individuals from the three Nigerian

major ethnic groups of different ancestral origin and of different geographical regions. The Yoruba adolescents had the most significantly higher normative orthodontic treatment need among the three major ethnic groups based on ICON.

6. RECOMMENDATION

The confirmation of ethnic variation in orthodontic need established in this study underscores the need for further studies involving the minor ethnic groups since Nigeria is a multiethnic country. This will enhance further understanding of the normative orthodontic treatment needs of the entire citizenry. This is desirable and should be encouraged. Furthermore, studies involving adult members of the population from different ethnic groups should equally be encouraged in order to characterize the need in this category of people who also sometimes require orthodontic interventions. Finally, documentation of such biologic variants such as occlusion and characterization of orthodontic treatment need could become a useful tool for differentiation in forensic investigations in Nigeria.

CONSENT

Informed and written consent was obtained from the parents of the participants while assent was obtained from the participants. Consent was also sought from the administrators of the nine schools that were involved in the study before any contact with the students.

ETHICAL APPROVAL

Ethical clearance was sought and obtained from the Ethical Committee of a tertiary health institution (UPTH/ADM/90/S.11/VOL.X/798).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Bellot-Arcis C, Montiel-company J, Almerich-Silla J. Orthodontic treatment need: An epidemiological approach. Orthodontics-Basic Aspects and Clinical considerations. Bourzgui F(Ed); 2012. Available:<http://www-intechopen.com/books/orthodontics>.
- World Health Organization: Maternal, newborn, child and adolescent health Geneva; 2013. Available:http://www.who.int/maternal_child_adolescent/topics/adolescent/dev/en
- Christie D, Viner R. Adolescent development. BMJ. 2005;330:301-304.
- Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. Societa Italiana di Ortodonzia SIDO. 2011; 12:132-142.
- Harulur S, Addas M, Othman H, Shah F, El-malki A. et al. Prevalence of malocclusion, its association with occlusal interferences and Temporomandibular disorders among the Saudi sub-population. Oral Health Dent Manag. 2014;13:164-169.
- Gass J, Valvathan M, Tiwari H, Hans M, Elston R. Familial correlations and heritability of maxillary midline diastema. Am J Orthod Dentofacial Orthop. 2003; 123:35-39.
- Johannsdottir B, Thorarinsson F, Thordarson A, Magnusson T. Heritability of craniofacial characteristics between parents and offspring estimated from lateral cephalograms. Am J Orthod Dentofacial Orthop. 2005;127:200- 207.
- Cassidy K, Harris E, Tolley E, Kiem R. Genetics influence on dental arch form in orthodontic patients. Angle Orthod. 1998; 68(5):445-454.
- Manfredi C, Martina R, Grossi G, Giuliani M. Heritability of 39 orthodontic cephalometric parameters on MZ, DZ twins and MN paired singletons. Am J Orthod Dentofacial Orthop. 1997;111(1):44-51.
- Kraus P, Lufkin T. Dlx homeobox gene control of mammalian limb and craniofacial development. Am J Med Genet Part A. 2006;140:1366-1374.
- Thesleff I. The genetic basis of tooth development and dental defects. Am J Med Genet Part A. 2006;140A:2530-2535.
- Klingenberg C. Evo-devodiscovers morphology. J Evol Biol. 2004;17(2):472-474.
- Draker HL. Handicapping labio-lingual deviations: A proposed index for public health purposes. Am J Orthod. 1960;46: 295- 305.
- Salzmann JA. Handicapping malocclusion assessment to establish treatment priority. Am J Orthod. 1968;54:749- 65.
- Grainger RM. Orthodontic treatment priority index in; Public Health Service Publication

- No 1000, Series 2, No 25 Washington DC: US Government Printing Office; 1967.
16. Summers CJ. A system for identifying and scoring occlusal disorders. *Am J Orthod.* 1971;59:552-67.
 17. Lundstrom A. Need for treatment in cases of malocclusion. *Trans Eur Orthod Soc.* 1977;111-123.
 18. Brook P, Shaw W. The development of an index of orthodontic treatment priority. *Eur J Orthod.* 1989;20:309-320.
 19. Richmond S, Shaw WC, O'Brien KD, Buchanan IB, Jones R, et al. The development of the PAR index: reliability and validity. *Eur J Orthod.* 1992a;14:125-139.
 20. Cons N, Jenny J, Kohout F. The dental aesthetic index, College of Dentistry, IOWA City, IA; 1986.
 21. Espeland LV, Ivarsson K, Stenvik A. A new Norwegian index of orthodontic treatment need related to orthodontic concern among 11 year olds and their parents. *Community Dent Oral Epidemiol.* 1992;20:274-279.
 22. King G, Kiyak HA, Huang G, Greenlee G. University of Washington, Seattle, USA.
 23. Cristina Grippaudo, Ester Giulia Paolantonio, Giuseppe La Torre, Maria Rosaria Gualano, Bruno Oliva et al. Prevalence of malocclusion in Italian School children and orthodontic treatment need. *Eur. J Paed Dent.* 2013;14:314-318.
 24. Perillo L, Masucci C, Ferro F, Apicella D, Baccetti T. Prevalence of orthodontic treatment need in Southern Italian school-children. *Eur J Orthod.* 2010;32:49-53.
 25. Christopherson E, Briskie D, Inglehart M, Habil P. Objective, subjective and self assessment of preadolescent orthodontic treatment need-A function of age, gender and ethnic/racial background. *Am J Orthod Dentofacial Orthop.* 2009;135:80-86.
 26. Reichmuth M, Keri A, Greene M, Orsini G, Cisneros G, et al. Occlusal perceptions of children seeking orthodontic treatment: impact of ethnicity and socioeconomic status. *Am J Orthod Dentofacial Orthop.* 2005;5:575-582.
 27. Aikins EA, Dacosta OO, Onyeaso CO, Isiekwe MC. Orthodontic treatment need and complexity among Nigerian adolescents in Rivers State, Nigeria. *Int J Dent.* 2011;1-6.
 28. Utomi IL, Onyeaso CO. Orthodontic treatment complexity and need in a Nigerian Teaching Hospital. *Oral Health Dent Manag.* 2014;13(3):561-567.
 29. Emmanuel OA. Normative and self-perceived orthodontic treatment need in Nigerian school children. *Acta Odontologica Scandinavica.* 2015;73(5):364-367.
 30. Onyeaso CO, Idaboh G. Orthodontic treatment complexity and need at UCH, Ibadan, Nigeria according to the Index of Complexity, Outcome and Need. *Paediatr Dent J.* 2006;16(2):128-131.
 31. National Population Commission. Population census of the Federal Republic of Nigeria Census Report. National Population Commission, Abuja; 2006.
 32. Hallam WK. The bayajida legend in Hausa folklore. *J Afr Hist.* 1966;7:47-60.
 33. Tak M, Nagarajappa R, Sharda AJ, Asawak, Tak A. Prevalence of malocclusion and orthodontic treatment needs among 12-15 years old school children of Udaipur, India. *Eur J Dent.* 2013;5:45-53.
 34. Borzabadi-Farahani A, Borzabadi-Farahani F, Eslamipour. Orthodontic treatment needs in an urban Iranian population, an epidemiological study of 11-14 year old children. *Eur J Paediatr Dent.* 2009;10:69-74.
 35. Liepa A, Urtane I, Richmond S, Dunstan F. Orthodontic treatment need in Latvia. *Eur J Orthod.* 2015;25(3):279-284.
 36. Onyeaso CO. Orthodontic treatment complexity and need with associated oral health related quality of life in Nigerian adolescents. *Oral Health Prev Dent.* 2009;7(3):235-241.
 37. Dias P, Gleiser R. Orthodontic concerns of Brazilian children and their parents compared to the normative treatment need. *J Oral Sci.* 2010;52:101-107.
 38. Asef K, Aleksejuniene J, Yen E. Orthodontic treatment need of adolescents in Haida Gwaii, Canada. University of British Columbia; 2013.
 39. Souames M, Bassigny F, Zenati N, Riordan PJ, Boy-lefevre M. Orthodontic treatment need in French School children; an epidemiological study using the index of orthodontic treatment need. *Eur J Orthod.* 2006;28:605-609.
 40. Lagana G, Masucci C, Fabi F, Bollero P, Cozza P. Prevalence of malocclusion, oral habits and orthodontic treatment need in 7 to 15 year old school children population in Tirana. *Prog Orthod.* 2013;14:12. DOI: 10.1186/2196-1042-14-12
 41. Grippaudo C, Paolantonio EG, Deli R, Torre GLA. Orthodontic treatment need in

- the Italian Child population. *Eur. J. Paed Dent.* 2008;9:71-75.
42. Baubiniene D, Sidlauskas A, Miseviciene I. The need for orthodontic treatment among 10-11 and 14-15 year old Lithuanian school children. *Medicina.* 2009;10:814-821.
43. Manzanera D, Montiel-Company JM, Almerich-Silla JM, Gandia JL. Orthodontic treatment need in Spanish School Children: An epidemiologic study using the index of orthodontic treatment need. *Eur J Orthod.* 2009;31:180-183.
44. Urtane I, Pugaca J, Liep A, Rogovska I. The severity of malocclusion and need for orthodontic treatment in correspondence with the age. *Stomatologija.* 2006;8:35-38.
45. Zreaqat M, Hassan R, Ismail A, Ismail N, Aziz F. Orthodontic treatment need and demand among 12-and 16 year-old school children in Malaysia. *Oral Health Dent Manag.* 2013;217-221.
46. Koochek AR, Yeh MS, Rolfe B, Richmonds. The relationship between index of complexity, outcome and need and patients' perceptions of malocclusion: A study in general dental practice. *Br Dent J.* 2001;191:325-329.
47. Onyeaso CO. Orthodontic treatment need of Nigerian outpatients assessed with the Dental Aesthetic Index. *Aust Orthod J.* 2004;20:19-23.
48. Anosike AN, Sanu OO, DaCosta OO. Malocclusion and its impact on quality of life of school children in Nigeria. *West Afri J Med.* 2010;29:417-424.
49. Tak M, Nagarajappa R, Sharda AJ, Asawak Tak A. Prevalence of malocclusion and orthodontic treatment needs among 12-15 years old school children of Udaipur, India. *Eur J Dent.* 2013;5:45-53.
50. Urtane I, Pugaca J, Liep A, Rogovska I. The severity of malocclusion and need for orthodontic treatment in correspondence with the age. *Stomatologija.* 2006;8:35-38.
51. Burden DJ, Holmes A. The need for orthodontic treatment in the child population of the United Kingdom. *Eur J Orthod.* 1994;16:395-399.
52. Zreaqat M, Hassan R, Ismail A, Ismail N, Aziz F. *Oral Health Dent Manag.* 2013; 217-221
53. Zahid S, Bashir U, Arshad N, Hafeezkaleem O, Hasan R, et al. Orthodontic treatment need in 13-30 years patients by using the index of orthodontic treatment need. *PODJ.* 2010;30:108-114.
54. Al-Atabi HS. Gender differences, facial profile and treatment need of malocclusion for a sample of Al-Muthanna Governorate students aged 15 years. *J Paed Orthod Prev Dent.* 2013;3:142-148.
55. Almeida AB, Leite IC. Orthodontic treatment need for Brazilian school children: A study using the dental aesthetic index. *Dental Press J Orthod* 2013;18:103-109.

© 2020 Etim et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<http://www.sdiarticle4.com/review-history/54898>