Orthodontic Treatment Needs of Adolescents in North-Western Nigeria Using the Index of Orthodontic Treatment Needs

Abstract

Introduction: Orthodontic treatment planning within a public health system needs information on the need for orthodontic treatment within the population. It is imperative to have epidemiological data from which the need for orthodontic care in any region can be estimated. The present study, therefore, aimed to determine the orthodontic treatment need of adolescents in North-Western Nigeria. **Materials and Methods:** A descriptive cross-sectional study was conducted of 200, 12–15-year-old schoolchildren in Northern Nigeria using the Dental Health Component (DHC) and Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN). A structured interview and clinical examination were used to assess the subjects. Descriptive statistics and χ^2 tests were used for data analysis with statistical significance set at $P < 0.05$. **Results:** There were 19.5% with definite need (DHC 4 or 5) for orthodontic treatment and 15.5% borderline need (DHC 3). The AC scores demonstrated that 1% of the studied subjects had a definite need (AC 8–10) for orthodontic treatment and 24% borderline need (AC 5–7). A statistically significant relationship between AC and DHC of IOTN among the study population ($P < 0.05$) was observed. **Conclusion:** Using the DHC of the IOTN, the proportion of subjects estimated to have great and very great treatment needs (grades 4 and 5) was 19.5%. However, only 1% of individuals were in need (grades 8–10) of orthodontic treatment according to the AC. Awareness about orthodontic treatment should be a part of public health planning for this region.

Keywords: *Adolescents, IOTN, Nigeria, orthodontic treatment need, orthodontics*

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Introduction

Majority of orthodontic patients are children and adolescents; therefore, information on the orthodontic treatment need among this demography allows convenient national budget planning. Orthodontic treatment is important because malocclusion has been linked not only to aesthetic concerns but also to functional limitations and psychological impact.[1] Information about the prevalence of malocclusion and need for orthodontic treatment allows for public health planning and informed national funds allocations.[2]

Several indices have been developed to grade orthodontic treatment need in order to manage increased demand for orthodontic treatment globally.[3,4] These indices have also been used in prioritizing the orthodontic treatment need of prospective patients.[5] One of such indices, namely, the Index of Orthodontic Treatment Need (IOTN), was developed by Brook and Shaw and has two separate components, the Aesthetic Component (AC) and Dental Health Component (DHC), which rank an individual's malocclusion according to aesthetics and dental health.[3,6] The IOTN is a valid tool for determining the need for orthodontic treatment in different countries and populations.[7-11]

Kano is the capital of Kano State situated in the North-Western geopolitical zone of Nigeria. Kano is the second largest city in the country with an estimated population of 371,243 based on the 2006 national census.[12] Kano is known to be a commercial as well as an agricultural city with most residents belonging to the Hausa ethnic group. Orthodontic treatment in this locality is paid out of pocket and largely considered to be unaffordable; there is also a shortage of orthodontists.[13]

There has been very little information on the orthodontic treatment need status of North-Western Nigeria. A search of literature revealed only one epidemiological study which compared orthodontic treatment need among adolescents from North-Western Nigeria to adolescents from two other major ethnic groups in Nigeria.[14] Since no previous attempt has been made to quantitatively assess the

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orthodontic treatment needs in the region using the IOTN, it is necessary to have epidemiological data to estimate need for orthodontic care in this region. The objective of this study was therefore to determine the need for orthodontic treatment using the IOTN and also to investigate whether age, gender, ethnicity, and religion have any relationship with this need in 12–15-year-old schoolchildren residing in Kano, North-Western Nigeria.

Materials and Methods

Ethics and consent

Ethical approval was obtained from the Kano State Ministry of Health (NHREC/17/03/2018). Consent was obtained from the parents/guardians of the participants while the participants gave assent for the study.

Study design

This is a descriptive cross-sectional study among secondary school students in Northern Nigeria.

Study location

The research was conducted at Faggae Local Government Area (LGA) of Kano State, North-Western Nigeria.

Study population

Participants were 200 adolescents aged 12–15 years attending secondary schools at Faggae LGA of Kano State in February 2020.

Inclusion criteria

Healthy Nigerian adolescents of both sexes aged 12–15 years who were willing to participate in the study were included with consent form signed by parents and assented to by participants.

Exclusion criteria

Individuals who had undergone orthodontic treatment and those with a history of jaw fracture were excluded.

Sample size determination

The sample size for this study was determined using Fisher's formula for descriptive cross-sectional studies.[15]

$$n = \frac{Z^2 pq}{d^2}$$

where

n = maximum sample size for the study;

z = standard normal deviate corresponding to 95% confidence level = 1.96 from the normal distribution table;

p = prevalence of malocclusion obtained from a previous study[16] in northern Nigeria (87.7%) = 0.877;

q = complementary probability which is $1 - p = 1 - 0.877 =$ 0.123;

d = degree of precision of 5%; therefor-e

$$n = \frac{(1.96)^2 \times (0.877 \times 0.123)}{(0.05)^2} = 165.8$$

Addition of 10% for non-response: $166 + 17 = 183$.

Minimum sample size was therefore 183 participants.

Sampling technique

A public and private secondary school was randomly selected from available secondary schools in Faggae LGA of Kano State. Then, samples were proportionally allocated to each selected school based on their corresponding population size. Sample frames were developed from a list of 12–15-year-old students from each selected school. Systematic random sampling was used to select the participants in each school from the sampling frame as follows:

$$\text{Sample Fraction} = \frac{\text{Sample Size}\,(100)}{\text{Sample Frame}\,(500)}$$

$$\text{Sample interval} = \frac{1}{\text{Sample Fraction}\left(\frac{1}{5}\right)}$$

Sampling interval = 5.

Data collection

The data were collected in the school compound during school hours under natural lighting conditions, with the student seated and the teeth in centric occlusion. A structured face-to-face interview was carried out before the respective clinical examination of each child.

A validated interviewer administered questionnaire was used to obtain information on sociodemographic characteristics.

Thereafter, a calibrated examiner conducted the clinical examination and rated the children AC scores. The examination was carried out in natural light using disposable gloves and wooden spatula. Each student's anterior teeth were assessed by comparing the appearance of their teeth to the AC of the IOTN photographs with grade 1 as the most attractive and grade 10 as the least attractive [Figure 1]. The grades of the AC which correspond to the numbers on the respective photographs, depicting the levels of treatment need, are as follows:

AC grades 1–4: no need for orthodontic treatment.

AC grades 5–7: borderline/moderate need for orthodontic treatment.

AC grades 8–10: definite need for orthodontic treatment.

In addition, occlusal anomalies of the DHC [Figure 2] were recorded and scored by the examiner. Intraoral measurements were made with a pair of sterile dividers (dbOrtho, West Yorkshire, UK) and transferred to a meter rule. The meter rule was subjected to high level disinfection (1:10 dilution of hypochlorite) after each use. The DHC grade was then determined according to the highest scoring anomaly.

Figure 1: Aesthetic Component of IOTN

Intra-examiner reliability

Thirty of the students were selected randomly and reexamined by the same examiner after a 4-week interval. Kappa reliability coefficient of 0.91 for DHC and 0.88 for AC were obtained indicating strong agreement.

Data analysis

Data were analyzed using IBM Statistical Package for Social Sciences software (SPSS) version 23. Quantitative variables were described using measures of central tendency and variability such as mean and standard deviation. Frequency distribution and percentage were carried out to describe categorical (qualitative) variables. The χ^2 test was used for comparison of categorical variables. Level of statistical significance was set at $P < 0.05$.

Results

A total of 200, 12–15-year-old schoolchildren with a mean age of 13.6 ± 1.1 years participated in the study. Table 1 shows the sociodemographic characteristics of the study population.

Slightly more of the participants, 101 (50.5%) were males, whereas female respondents constituted 49.5% ($n = 99$) of the total sample. Majority of the respondents, 79 (39.5%) were Hausa by tribe, followed by Yoruba 53 (26.5%), whereas Igbo constituted 34 (17%) with only 13 (6.5%) Fulanis. Other tribes Kanuri, Ijaw, Tiv, Babur, Itsekiri, and Egbira constitute 10.5%.

Table 2 demonstrates the assessment of the AC of the IOTN among the schoolchildren. Majority of the participants 150 (75.0%) had no need for treatment, 48 (24.0%) had moderate need for treatment, whereas only 2 (1.0%) were found to have definite need for treatment.

There was no significant relationship between the distribution of the AC of IOTN and the various sociodemographic factors such as age, gender, ethnicity, and religion ($P > 0.05$), as seen in Table 3.

The assessment of the DHC of IOTN among the study population is indicated in Table 4. Majority of the respondents [130 (65.0%)] were found to have no need for treatment, 31 (15.5%) were found to have moderate need for treatment, whereas 39 (19.5%) were found to have severe need for treatment. Table 5 shows that

Grade 1—No treatment required	
1.	Extremely minor malocclusions, including displacements less than 1 mm
Grade 2—Little need for treatment	
2.a	Increased overjet > 3.5 mm but " 6 mm (with competent lips)
2.b	Reverse overjet greater than 0 mm but " 1 mm
2.c	Anterior or posterior crossbite with " 1 mm discrepancy between RCP and ICP
2.d	Displacement of teeth > 1 mm but " 2 mm
2.e	Anterior or posterior open bite > 1 mm but " 2 mm
2.f	Increased overbite ≥ 3.5 mm (without gingival contact)
2.g	Prenormal or postnormal occlusions with no other anomalies (up to ½ a unit of discrepancy)
Grade 3—Borderline need for treatment	
3.a	Increased overjet > 3.5 mm but " 6 mm (incompetent lips)
3.b	Reverse overjet greater than 1 mm but " 3.5 mm
3.c	Anterior or posterior crossbites with > 1 mm but " 2 mm discrepancy between RCP and ICP
3.d	Displacement of teeth > 2 mm but " 4 mm
3.e	Lateral or anterior open bite > 2 mm but " 4 mm
3.f	Increased and incomplete overbite without gingival or palatal trauma
Grade 4—Treatment required	
4.a	Increased overjet > 6 mm but " 9 mm
4.b	Reverse overjet > 3.5 mm with no masticatory or speech difficulties
4.c	Anterior or posterior crossbites with > 2 mm discrepancy between RCP and ICP
4.d	Severe displacements of teeth > 4 mm
4.e	Extreme lateral or anterior open bites > 4 mm
4.f	Increased and complete overbite with gingival or palatal trauma
4.h	Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis
4.l	Posterior lingual crossbite with no functional occlusal contact in one or more buccal segments
4.m	Reverse overjet > 1 mm but < 3.5 mm with recorded masticatory and speech difficulties
4.t	Partially erupted teeth, tipped and impacted against adjacent teeth
4.x	Existing supernumerary teeth
Grade 5—Treatment required	
5.a	Increased overjet > 9 mm
5.h	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant requiring pre-restorative orthodontics)

Figure 2: Dental Health Component of IOTN

there was no significant relationship between the distribution of the DHC of IOTN and the various sociodemographic factors such as age, gender, ethnicity, and religion ($P > 0.05$).

There was a statistically significant relationship between AC and DHC of IOTN among the study population ($P < 0.05$). This implies that there is agreement between the two components of IOTN as assessed in the study population [Table 6].

Discussion

The IOTN is a standard and validated index that assesses the need for orthodontic treatment of an individual according to aesthetic considerations and dental health implications.[17] This study has provided some baseline data for the orthodontic treatment needs of adolescents residing in North-Western Nigeria. The DHC revealed that about a third of the study

population had a need for treatment, whereas the AC revealed that a quarter of participants would need orthodontic treatment due to aesthetic concerns. Overall males and those not from the Hausa ethnic group had a greater need for orthodontic treatment, though not statistically significant. There was no relationship between religion and orthodontic treatment need of our participants.

A combined need for treatment (moderate and severe) as assessed by the DHC was found in 35% of our population. This is slightly lower than the need of 38.1% assessed in adolescents in South Nigeria[18] but higher than 31.5% found in a similar population in North-Western Nigeria in which the Index of Complexity, Outcome, and Need was used.[14] The magnitude of need is however much lower than that found among Saudi Arabian children (55.4%).[19] This difference may be due to ethnic and racial variations as has been identified in another Nigerian study.[20]

While our finding is comparable with that seen among Ethiopian children[6] with 30% of respondents with orthodontic treatment need, it is however higher than 32.7% need assessed in the UK,[17] 29.9% in Peru,[21] and 27.3% in Italy.[22] This may be due to institutionalized preventive and interceptive orthodontic programmes carried out routinely early in life in these countries. For example, in Italy the Baby Risk of Malocclusion Index (Baby ROMA) is used for orthodontic screening in children aged 2–6 years.[23] Such orthodontic screenings and interceptive methods until very recently were non-existent in North-Western Nigeria.[13]

Table 1: Sociodemographic characteristics of participants

Variables	Frequency (*n*=200)	Percentage
Age		
12 years	45	22.5
13 years	50	25.0
14 years	55	27.5
15 years	50	25.0
Gender		
Male	101	50.5
Female	99	49.5
Ethnicity		
Hausa	79	39.5
Fulani	13	6.5
Yoruba	53	26.5
Igbo	34	17.0
*Others	21	10.5
Religion		
Islam	112	56.0
Christianity	88	44.0

*Others: Kanuri, Ijaw, Tiv, Babur, Itsekiri, and Ebira

Table 2: Assessment of the Aesthetic Component (AC) of 12–15-year-old school adolescents

Components	Grades	Frequency (*n* = 200)	Percentage
No need for treatment	1–4	150	75.0
Moderate need for treatment	5–7	48	24.0
Definite need for treatment	8–10	2	1.0

Table 3: Relationship of sociodemographic factors and Aesthetic Component (AC) among 12–15-year-old school adolescents

Components	Aesthetic components			Total	χ^2	*P*-value
	No need	Moderate need	Definite need			
Age (years)						
≤13	68 (71.6)	26 (27.4)	1 (1.1)	95 (47.5)	1.143	0.660
>13	82 (78.1)	22 (21.0)	1 (1.0)	105 (52.5)		
Gender						
Male	75 (74.3)	24 (23.8)	2 (2.0)	101 (50.5)	1.980	0.622
Female	75 (75.8)	24 (24.2)	0 (0.0)	99 (49.5)		
Ethnicity						
Hausa	58 (73.4)	20 (25.3)	1 (1.3)	79 (39.5)	0.230	0.873
Non-Hausa	92 (76.0)	28 (23.1)	1 (0.8)	121 (60.5)		
Religion						
Islam	82 (73.2)	29 (25.9)	1 (0.9)	112 (56.0)	0.517	0.757
Christianity	68 (77.3)	19 (21.6)	1 (1.1)	88 (44.0)		

Table 4: Assessment of the Dental Health Component (DHC) of 12–15-year-old school adolescents

Components	Grades	Frequency (*n* = 200)	Percentage
No need for treatment	1–2	130	65.0
Moderate need for treatment	3	31	15.5
Severe need for treatment	4–5	39	19.5

Table 5: Relationship of sociodemographic factors and Dental Health Component (DHC) among 12–15-year-old school adolescents

Components	Dental Health Component (DHC)			Total	χ^2	*P*-value
	No need	Moderate need	Severe need			
Age (years)						
≤13	62 (65.3)	14 (14.7)	19 (20.0)	95 (47.5)	0.093	0.956
>13	68 (64.8)	17 (16.2)	20 (19.0)	105 (52.5)		
Gender						
Male	67 (66.3)	12 (11.9)	22 (21.8)	101 (50.5)	2.325	0.317
Female	63 (63.6)	19 (19.2)	17 (17.2)	99 (49.5)		
Ethnicity						
Hausa	49 (62.0)	15 (19.0)	15 (19.0)	79 (39.5)	1.220	0.543
Non-Hausa	81 (66.9)	16 (13.2)	24 (19.8)	121 (60.5)		
Religion						
Islam	70 (62.5)	22 (19.6)	20 (17.9)	112 (56.0)	3.416	0.185
Christianity	60 (68.2)	9 (10.2)	19 (21.6)	88 (44.0)		

Table 6: Relationship between the Aesthetic Component (AC) and Dental Health Component (DHC) in the study population

Components	AC			Total	χ^2	*P*-value
	No need	Moderate need	Definite need			
DHC						
No need for treatment	129 (99.2)	1 (0.8)	0 (0.0)	130 (65.0)	12.210	*0.01
Moderate need for treatment	12 (38.7)	19 (61.3)	0 (0.0)	31 (15.5)		
Severe need for treatment	9 (23.1)	28 (71.8)	2 (5.1)	39 (19.5)		

*Statistically significant

The AC revealed a treatment need of 25% (moderate 24%, definite 1%) among our study participants. This is much higher than that assessed among Ethiopian children,[6] Indonesian adolescents (19.6%),[24] Spanish adolescents,[25] and Turkish adolescents,[26] but lower than 55.5% obtained in Indian adolescents.[27] Differences may be due to age of study populations as malocclusion has been shown to worsen with age,[28] as well as ethnic variations in perceptions of beauty. Male participants were found to have a greater need for treatment than females as has been seen in studies in Greece[29] and Nigeria,[14] whereas a Syrian study did not find any sex predilection.[30]

Although the DHC identified a greater need for treatment among the adolescents than the AC, there was agreement between the two parts of this index which was statistically significant. This indicates that the IOTN is accurate and valid for use in Nigeria, as was concluded in a similar study of young adults in Saudi Arabia.[31]

This study did not capture the orthodontic treatment needs of young children and adult population in Northern Nigeria, which may be a limitation to assessing the total orthodontic treatment need in North-Western Nigeria. We therefore recommend that further studies be done on these populations to give a more comprehensive view which will also help in the assessment of the required orthodontic manpower needed in this region of Nigeria.

Conclusion

The proportion of subjects estimated to have great and very great treatment need (DHC grades 4 and 5) was 19.5%. However, only 1% of individuals were in definite need (grades 8–10) of orthodontic treatment according to the AC. Overall males and those not from the Hausa ethnic group had a greater need for orthodontic treatment, although these findings were not statistically significant. There was no relationship between religion and orthodontic treatment need of our participants.

The findings of this study are important for orthodontic practice in North-Western Nigeria because it has provided some baseline data as well as identified the magnitude of the problem among adolescents who are the vast majority of orthodontic patients. This should help to fashion public health policies particularly in the National Health Insurance Scheme to enable many more of those individuals who may not be able to afford treatment to access care and thus improve their quality of life.

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Conflicts of interest

There are no conflicts of interest.

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