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The orthodontic treatment needs in children aged 12-15 years in a school in Khomas, Namibia: A cross-sectional study

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Orthodontics, Khomas, Namibia, Children, Treatment need, Perceived need, Normative need, Index of Orthodontic Treatment need (IOTN), Modified Dental Health Component, Aesthetic Component.

ABSTRACT

The aim of this study was to determine the orthodontic treatment needs of a population of 12-15 year old school children and to express it as percentages of those subjective and objective orthodontic treatment need over the whole sample population.

There has been a disagreement between normative and subjective need for orthodontic treatment. This is especially true in an African setting.

The aim of this cross-sectional study was to determine the orthodontic treatment needs of a population of 12–15-year-old children attending a school in Khomas, Namibia. The Modified Index of Orthodontic Treatment Need (IOTN), using the Dental Health Component (DHC) and the Aesthetic Component (AC), was used to determine the normative and subjective need for orthodontic treatment respectively.

One hundred and two participants were examined, of which 36.2% were males and 63.7 % were female. The normative need as measured by the DHC was 59.8%. The subjective need was 17.7% and 31.4% as measured by the Child-rated AC (CRAC) and Examiner-rated AC (ERAC) respectively. There were no significant associations between Orthodontic treatment need and gender or age. Although there was a minimal subjective need for orthodontic treatment, there was a relatively high normative need for orthodontic treatment recorded by the researcher. The association between DHC and CRAC revealed that 88.8% of the children shown to have normative need also perceived need according to the CRAC. Of the 70 children with no need for treatment according to Examiner, 91.4% of the children agreed.

In assessing orthodontic treatment need, the normative need was higher than the perceived need. This discrepancy could be due to the IOTN tool not being Afrocentric and thus overestimating the treatment needs of children. The expert's objective assessment may not always agree with the child's perception of the problem, especially in an African setting.

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1. LITERATURE REVIEW

Malocclusion is defined as an irregularity of the teeth or a mal-relationship of the dental arches beyond the range of what is accepted as normal [1]. Malocclusion is classified under handicapping dentofacial anomalies by the World Health Organization [2]. According to a global systematic review, the prevalence of malocclusion was 56%[3]. Prevalence of malocclusion differed according to differences in races/ethnicity, countries, age range of the surveyed children, and setting [3.5]

The majority of patients seek orthodontic treatment primarily to improve their aesthetics and self-esteem [4-8], with anterior teeth malalignment being the most common presenting complaint [9]. Malocclusion can have a negative impact on patients' oral health related quality of life [10]. The need for orthodontic treatment is dependent on how the patient perceives their condition and how much function and aesthetics is affected [11,12]. Self-perceived and normative need does not always lead to the utilization of service any more than the availability and utilization infers a need [13,14]. People will seek treatment depending on their difficulty in functional and esthetic concerns [15-18], dissatisfaction with their appearance [15], enhanced self-confidence and patient perceptions of need [16].

Traditionally, the common model of oral health needs assessment depends almost entirely on dental or orthodontic professionals' opinions [19,20]. Normative need assessment refers to the impairments and diseases which an expert, administrator or scientist defines as need [20]. A major shortcoming, however, is that wider concepts of general health which consider the incorporation of functional, psychological and social well-being in patient care are not usually accounted for in the normative approach [20].

Rather than a disease, it has been shown in most patients that malocclusion is a deviation from a documented average therefore making psychological and social factors integral to the distinction between acceptable and unacceptable occlusion [21]. Self- esteem, peer group norms, previous orthodontic treatment, gender, age, and socio-economic background, are some of the factors that have been seen to affect an individual's perception of dental appearance,

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malocclusion and the readiness to receive and comply with orthodontic treatment [22-24].

In assessing orthodontic treatment need, it is best to use an index that is standardized so that comparisons can be done with other populations classified by the same criteria and methods [25,26]. The Index of Orthodontic Treatment Need (IOTN) is one of the most widely used occlusal indices in epidemiological studies [27,28]. The IOTN combines aesthetic components and dental health components, namely the Dental Health Components (DHC) and Aesthetic Components (AC) [29].

This will be the first time that the prevalence of malocclusion will be studied in Namibia using a tool that was created for a Eurocentric audience.

The aim of this cross-sectional study was to assess the orthodontic treatment needs in a sample population of Namibian school children aged 12-15 years in a school in Khomas.

2. MATERIALS AND METHODS

Ethics approval was sought from BMREC at Ethics committee of University of the Western Cape (Registration number BM18/3/19). Authors confirm that this study was performed in accordance with relevant guidelines and regulations of the Declaration of Helsinki [30]. Informed consent was taken from all parents/guardians of all included participants and informed assent was taken from all included participants. The Region of Khomas was chosen for this study as it represents a diverse group of children and has the largest population of all regions in Namibia. According to the 2011 census, there are 342,141 people out of the total population of 2,113,077, making it 16%. Therefore, a representative sample could present a diverse view and understanding of malocclusion and perceived orthodontic treatment needs and it also has a diverse socio-economic grouping.

Using a list of schools in the area obtained from the Department of Education's EMIS, (Education Management Information System) a school was selected based on the ethnic diversity primarily found in this school. The inclusion criteria consisted of participants whose parents gave informed consent and who were 12–15-year-olds, in Grades 6-9 were invited to participate (174 children). This particular age range was chosen as malocclusion becomes more prominent at this age and adolescents are more aware of their appearance and it can impact their OHRQoL.

The exclusion criteria were that participants had to not have current or previous orthodontic treatment, had cranio-facial abnormalities, if consent was not obtained from parents or if assent was not obtained from the participant.

Convenience sampling was used to select individuals to participate in the study. Information sheets were provided to the parents and children and written consent was obtained for clinical examination and answering the questionnaires.

In assessing orthodontic treatment need, it is best to use an index that is standardized so that comparisons can be done with other populations classified by the same criteria and methods [25,26]. . The IOTN combines aesthetic components and dental health components, namely the Dental Health Components (DHC) and Aesthetic Components (AC). The DHC has 5 grades: Grade 1 being "no need for treatment, Grade 5 being "Treatment need' while the grades in between denote varying degrees of malocclusion severity and treatment need.

Grade 1	No treatment
Grade 2	Minor anomaly, no treatment need
Grade 3	Borderline treatment need
Grade 4	Treatment need
Grade 5	Treatment need

The DHC is based on the evaluation of 5 occlusal traits with the acronym MOCDO

- Missing teeth: This includes aplasia, displaced and impacted teeth. Hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for prosthesis.
- Overjet: Includes reverse sagittal overjet. Increased overjet greater than 6mm. Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties. Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory and speech difficulties.
- Crossbite: Anterior or posterior crossbites with greater than 2 mm discrepancy between retruded contact position and intercuspal position.
- Displacement: Contact point displacements greater than 4 mm.
- Overbites: Including Lateral or anterior open bites greater than 4 mm. Deep overbite with gingival or palatal trauma.

The Aesthetic Component (AC) consists of 10 standard reference photographs representing different grades of dental attractiveness (Figure 1). The rating is based on matching the dental appearance of the patient with one of the photographs by the dentist and/or any other non-professional. Grade 1 represents the most attractive and grade 10, the least attractive. Brook and Shaw, 1989.
A rate is awarded for overall dental attractiveness and not necessarily the specific similarities to the photographs. The final value reflects the treatment need on the grounds of aesthetic impairment and by implication of the social psychological need for orthodontic treatment [31].

The need for treatment is determined as follows:
Grades 1-2: No need for treatment
Grades 3-4: Slight need for treatment
Grades 5-7: Moderate need for treatment
Grades 8-10: Definite need for treatment

In the Modified IOTN, The AC maintains the same ten-point scale but the recording is simplified in that Grades 1-7 indicate no need for treatment and Grades 8-10 indicate a need for treatment. The Modified IOTN aims to simply identify people in need of orthodontic treatment and not necessarily the complexity of the occlusal anomaly (Carlos Bellot-Arcis, 2012). This in turn improves the reliability and validity of the index [31].

The objective need for orthodontic treatment was determined by using the Dental Health Component (DHC) of the Modified IOTN. The subjective need for orthodontic treatment was determined by using the Aesthetic Component (AC) of the

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Modified IOTN. The Aesthetic Component of the IOTN (AC) was used to capture the subjective orthodontic treatment need (both the child's perceived treatment need CRAC as well as the examiner rated treatment need ERAC). Intra-oral examinations were carried out for the use of the Aesthetic component and the Dental Health component of the IOTN. The examiner was trained and calibrated against two independent competent examiners (kappa statistic was 0.906). Intra-examiner reliability and reproducibility tests were carried out during the examinations to make sure the data remained reliable. Unfortunately, test-retest scores were not recorded.

The study included two questionnaires per family: One to the child being examined to capture demographics and determining their self-assessed need for orthodontic treatment, and one to the child's guardian to determine the socio-economic status of the child. To ensure anonymity, the survey did not contain information that could personally identify the participants. All hard data was securely locked away in a filing cabinet and soft copies kept using password-protected computer files.

The Dental Health Component was used to determine the normative (objective) need for orthodontic treatment as well as to record the presence of malocclusion. The child was asked to sit or to stand in front of the examiner and with the use of natural light the examiner carried out an intra-oral examination of the dentition. No radiographs, study models or previous records were used.

Using the DHC of the modified IOTN, a distinction was made between those individuals with a definitive treatment from those with no definitive treatment need.
Therefore, each child was examined and according to the scale, if one of the conditions described in the DHC of the modified IOTN was found, a 1 was allotted and no further conditions were sought.

The ten-point scaled illustration by a series of photographs rated for attractiveness by a panel of lay judges was used as the tool to determine the felt need. In an effort to avoid bias, a random series of photographs were presented to the children in place of the standard AC pictograph. The child was seated in front of the examiner in natural light and asked to bite on their back teeth and smile for the assessment by the examiner. The examiner then studied the smile and an examiner-rated grade was picked from the 10-point scale and recorded. A rating was allocated for overall dental attractiveness rather than specific similarities to the photographs. This exercise took 1-2 minutes per child.

Each child was asked to fill in a questionnaire; the questions were few and limited to capturing demographics, self-assessed grading according to the AC of IOTN and an opinion on the need for treatment. In the questionnaire, the child was also asked to pick a grade on the scale that they feel best represents their own dental attractiveness.

To obtain information regarding the socio-economic status a questionnaire on education level, location of dental services, receipt of social grants, household amenities and employment status was provided for the guardians to complete.

The relationship between the examiner- rated AC and the child rated AC was analyzed. The relationship of AC compared to the DHC in the determination of the orthodontic treatment need and various other factors which affected the need for orthodontic treatment were also analyzed.

With a statistical level of confidence of 95%, an expected proportion of 80%, and a precision of 0.05. The sample size was calculated to be 103.

Differences in groups for continuous data were evaluated using a t-test if the data was normally distributed. Differences in categorical data were evaluated using Chi square test. Data analysis was performed using STATA software version 15. A statistical *p* value was set at 0.05 to denote statistical significance.

3. RESULTS

3.1 Demographic Information

There were 174 children in grade 7- 10 that were invited to participate in the study, 102 children and their guardians gave their informed consent. Three participants were excluded because two were currently receiving orthodontic treatment and the other participant was not eligible due to their age. Of the 102 participants, 65 (63.7%) were female and 37 (36.2%) were male.

Table 1: Demographic information of the sample

Variable	Total n (%)
Gender	
Female	65 (63.7)
Male	37 (36.2)
Age	
12	9 (8.8)
13	27 (26.5)
14	40 (39.2)
15	26 (25.5)
Frequency of visits	
0 x annually	60 (58.8)
1-2 x annually	36 (35.3)
More than 2 times annually	6 (5.9)
Highest education level of parent	
Grade 12	6 (5.9)
Certificate	15 (14.7)
Diploma	45 (44.1)
Undergraduate Degree	34 (33.3)
Postgraduate Degree	2 (1.9)
Home	
Own	48 (47)
Rent	40 (39.2)
Lives with family	14 (13.7)
Transport	
Own car	61 (59.8)
Hire a taxi	29 (28.4)
Walks to school	12 (11.7)

The majority (39.2%, n=40) of the study population consisted of fourteen-year-olds (Table 1). More than 58% (n=60) of the sample population do not visit the dentist at least once per year, while only 5.9% (n=6) visited the dentist more than twice per year. Ninety-four percent (n=96) of the guardians who returned the questionnaire were employed. More than 87% (n=89) of the guardians did not receive any form of social grant while 12.8% (n=13) received some form of social grant.

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All of the participating guardians had some basic education. The majority, 44.1% (n=45) were diploma holders while only 1.9% (n=2), were in possession of postgraduate degree. undergraduate degrees, certificate holders and Grade 12 holders made up 33.3% (n=34), 14.7% (n=15), and 5.9% (n=6) of the sample respectively.

All the participants were shown to have electricity and piped water in their homes. 59.8% (n=60) of the guardians owned cars, 28.4% (n=29) hired a taxi (rented a car) to take their children to school while 11.7% (n=12) of the children walk to school.

As far as housing is concerned, 47% (n=48) lived in their own home, 39.2% (n=40) rented a home and 13.7% (n=14) lived with family.

Age

The highest number of children (39.2%, n=40) who participated were 14-year-olds and this age group had the highest number of children in definite need for treatment objectively. There was no statistically significant association between age and DHC (p=0.528) (Table 2).

There was no statistically significant association between Age and CRAC, $p = 0.846$. There was also no statistically significant relationship between ERAC and age (p=0.081).

Sex

Although 39 (60%) of the 65 females and 22 (59.4%) of the 37 males were identified as having definite need for treatment, there was not a statistically significant association between DHC and Gender (p=0.957). There was no statistically significant association between Gender and CRAC, p=0.296.

Dental Visits

It was found that the children who visited the dentist more than once a year had a very low need for treatment according to the DHC of the modified IOTN. There was no statistically significant association between DHC and visits, $p = 0.439$. The children who visited the dentist more than once per year were shown to perceive their need for treatment as lower than those who visited the dentist less or not at all. There was no statistically significant association between Visits and CRAC, $p = 0.828$.

Socio-Economic factors

Employment

DHC and Employment

Just over 57% (n=55) of the children whose parents were employed were shown to have a definite need for treatment according to the DHC. There was a statistically significant relationship between employment status and DHC need (p=0.041) (Table 3)

Table 2: DHC (Dental Health Component), ERAC (Examiner Aesthetic Component) and CRAC (Child Aesthetic Component) and the demographic variables

		CRAC			DHC			ERAC		
		Need	No need		Need	No need		Need	No need	
Age	12	1 (11.11)	8 (88.89)	0.846	7 (77.78)	2 (22.22)	0.528	6 (66.67)	3 (33.33)	0.081
	13	6 (22.22)	21 (77.78)		17 (62.96)	10 (37.04)		9 (33.33)	18 (66.67)	
	14	6 (15)	34 (85)		24 (60)	16 (40)		12 (30)	28 (70)	
	15	5 (19.23)	21 (80.77)		13 (50)	13 (50)		5 (19.23)	21 (80.77)	
Gender	Female	10 (15.38)	55 (84.62)	0.296	39 (60)	26 (40)	0.957	19 (29.23)	46 (70.77)	0.537
	Male	8 (21.62)	29 (78.38)		22 (59.46)	15 (40.54)		13 (35.14)	24 (64.86)	
Employed	No	1 (16.67)	5 (83.33)	0.715	6 (100)	0 (0)	0.041*	4 (66.67)	2 (33.33)	0.076
	Yes	17 (17.71)	79 (82.29)		55 (57.29)	41 (42.71)		28 (29.17)	68 (70.83)	
Grant	No	15 (16.85)	74 (83.15)	0.412	51 (57.3)	38 (42.7)	0.148	25 (28.09)	64 (71.91)	0.062
	Yes	3 (23.08)	10 (76.92)		10 (76.92)	3 (23.08)		7 (53.85)	6 (46.15)	
Visits	Never	11 (18.33)	49 (81.67)	0.828	35 (58.33)	25 (41.67)	0.439	16 (26.67)	44 (73.33)	0.221
	At least once	7 (16.67)	35 (83.33)		26 (61.9)	16 (38.1)		16 (38.1)	26 (61.9)	
Total		18 (17.65)	84 (82.35)		61 (59.8)	41 (40.2)		32 (31.37)	70 (68.63)	

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More than 82% (n=79) of the children whose parents were employed did not perceive need for treatment for their own dentition. There was no statistically significant association between Employment and CRAC, $p = 0.715$.

Grant

Ten (77%) of the 13 children whose parents receive a grant were found to have need for orthodontic treatment while only 3 (25.7%) of the children whose parents do not receive a grant were found to have a need for treatment (Table 3). However, there was no statistically significant association between DHC and Grant, p=0.148

Of the 89 guardians who did not receive grant 74 (83.1%) of their children did not perceive a need for treatment. On the other hand, 23.1% of the 13 who receive a grant perceive a treatment need. However, there was no statistically significant association between CRAC and grant, $p = 0.412$.

Dental Health Assessment

Dental Health Component (DHC), ERAC (Esthetic Component) and CRAC (Child Aesthetic Component)
Of the 102 participants, 59% (n=61) presented a definite need for orthodontic treatment (DHC). More than 17% (n=18) of the 102 participants found that they had a need for orthodontic treatment (CRAC). 31.4% (n=32) were found to have need for orthodontic treatment according to the AC grade chosen by the examiner (ERAC) (Table 2).

Of the 68.6% (n=70) who do not need treatment according to the examiner, 76.2% (n=64) of the children were in agreement (Table 3).

There was a statistically significant association between CRAC and ERAC, $\chi^2(1) = 12.65$, $p < 0.001$.

Aesthetically, the examiner recorded 31.3% (n=32) in need of treatment according to the ERAC of the IOTN (Table 3). Of the 32 children who were shown to be in need of orthodontic treatment by the ERAC, 30 (49.18%) were in agreement according to the objective DHC ($p < 0.001$) (Table 3).

Thirty-nine (95.12%) participants who did not show need according to DHC, also did not perceive need for treatment aesthetically (p=0.004*) (Table 3).

4. DISCUSSION

There was a low CRAC for the sample, but a reasonably high DHC component. This shows that the modified IOTN may not be the most ideal tool to detect treatment need in an African setting. What may appear to be a "normal" occlusion for a child (CRAC) may not necessarily be the same for an examiner (ERAC) or by the normative (DHC) assessment. This could be due to the skewed determination of a normative assessment of occlusion, which is more suited for a non-African setting. Malocclusion for an African setting may include diastemas, bimaxillary protrusion, cres and open bites, which are all not included in the modified IOTN. The other reasons that the CRAC was much lower than the DHC and ERAC could be because of cultural perceptions of beauty. Community members tend to resemble one another and certain characteristics such as diastemas may be common and seen as a sign of wisdom or even attractive [32]. Therefore, a non-community member may view a somewhat "normal" appearance of a population and deem it an abnormality. When in fact, it is a culturally accepted form of beauty [33].

Dental aesthetics in communities where health is not prioritized, would not necessarily view malocclusion as a "problem". Poorer communities may experience more health-related issues. Factors such as education, age, employment status and dental visitation frequency may affect the awareness and perception of dental aesthetics. However, in this sample education, age, employment status or dental visitation frequency had no impact on CRAC or ERAC.

The findings in this study are consistent with those of Siddiqui et al (2014) who concluded that the patient and orthodontist tend to perceive patient malocclusions as more aesthetically pleasing. In a study on South African children [34], 81.7% of the children graded themselves aesthetically pleasing with only 6.9% showing a definite need for orthodontic treatment. Similarly, the Examiner rated AC showed that 25.2% were in definite need for treatment while 56.2% fell into the "no to slight need for treatment" category. In a Nigerian study, 65 % were found to have no need for treatment according to the AC of the IOTN [35]. This finding reinforces our study's results that malocclusion using a modified IOTN would not accurately describe the CRAC of African children.

Like this study, others found a lack in significance statistically between the two genders [36]. They found that gender did not play a significant role at all in perception of orthodontic need and treatment uptake [37,38]. The normative need for orthodontic treatment, on the contrary, was shown to be higher in men than in women [36,37].

Table 3: DHC (Dental Health Component) VS ERAC (Examiner Aesthetic Component) VS CRAC (Child Aesthetic Component)- a correlation analysis

		ERAC			DHC			CRAC		
		Need	No need		Need	No need		Need	No need	
CRAC	Need	12 (66.67)	6 (33.33)	0.001*	16 (88.89)	2 (11.11)	0.004*			
	No need	20 (23.81)	64 (76.19)		45 (53.57)	39 (46.43)				
DHC	Need	30 (49.18)	31 (50.82)	<0.001*				16 (26.23)	16 (73.77)	0.004*
	No need	2 (4.88)	39 (95.12)					2 (4.88)	2 (95.12)	

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With regards to gender, other studies done in South Africa, Kenya and Tanzania [34,39,40] had similar results. Some studies have shown females to be more critical of their dental appearance [41-43], while others concluded that males were more likely to seek orthodontic treatment than females (Otuyemi 1995,[36,37].

Body image perception differs with age. Adolescents and younger adults are more conscious and have higher expectations than children though they may be unwilling to undergo treatment [44]. By age 12, a child's dentition consists of permanent teeth and most or all the primary teeth have been shed therefore it is usually at this age that orthodontic treatment is initiated [45,46]. Similarly, by this age, the child has reached the stage in which they develop new tools for abstract and deductive thinking [47,48]. This further emphasizes this age group as an attractive target for research in dentistry particularly orthodontics because of body image and self-perception [49]. In this study age was not associated with CRAC, DHC or ERAC.

Socio-economic backgrounds influence orthodontic treatment need because the education, access, availability and affordability vary in different socio-economic groups, with the higher end usually more advantaged._

The modified IOTN has been used in various studies across the world to assess Orthodontic treatment need. In a South African study, Rampersadh (2015) found that the normative need for orthodontic treatment was higher than the patient's self-perceived need (child rated AC), and also lower than the examiner's perceived need (examiner rated AC) [34].

5. CONCLUSION AND RECOMMENDATIONS

There was a discrepancy between the CRAC, ERAC and DHC. From this we can conclude that there is a general need for orthodontic treatment even though the general perception by children and the examiner says otherwise. Therefore, there is a need for dialogue with regards to treatment needs and expectations between the child, guardian and orthodontist before treatment starts to ensure that the child understands and a good outcome is realized.

Also significant is the high need for orthodontic treatment objectively despite being in a middle to high socioeconomic status. It shows that there is a lack of awareness of malocclusions and as such the need for orthodontic treatment.

Based on the results of this study, a recommendation can be made that a large-scale survey on malocclusion prevalence and orthodontic treatment needs be carried out. Of significance would also be the creation of an awareness campaign on orthodontic treatment especially for those that have the need.

Considering the ERAC and CRAC were similar in their assessment with the greater percentage showing no need for treatment, it would be valuable to modify the index to include subjects with common African features, which may seem normal but are actually malocclusions.

Limitations to the study were:
Guardians who did not give consent to the children at all or in time therefore reducing the sample size

With regards to the AC of the IOTN, the photographs were based on Caucasian 12-year olds and have been stated as being referenced to this group and not any other ethnic groups [50].Therefore, some occlusal profiles, which are endemic to African ethnicity, may not be regarded as malocclusions thereby affecting the subjective perceptions for orthodontic treatment in both the child and the examiner

The study's results cannot be extrapolated to the rest of Namibia as it only examined one area in Namibia
No test-re-test reliability was performed

6. DECLARATIONS

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author contributions

All authors wrote the main manuscript text and FKD and KS prepared Tables 1-3. All authors reviewed the manuscript.

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Ethics approval and consent to participate

Ethics approval was sought from BMREC at University of the Western Cape (Registration number BM18/3/19). Informed consent and assent was obtained from parents and participants.

Consent for publication

NA

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

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Abbreviations

IOTN	Index of Orthodontic Treatment Need
DHC	Dental Health Component
AC	Aesthetics Component
WHO	World Health Organization
ERAC	Examiner-rated Aesthetic Component
CRAC	Child-rated Aesthetic Component
DAI	Dental Aesthetics Index

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The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.