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E.A. Mugonzibwa, DDS, Assistant Lecturer, Department of Preventive and Community Dentistry, Faculty of Dentistry, Muhimbili University College of Health Sciences, Dar es Salaam, Tanzania. A.M. Kuijpers-Jagtman, DDS, PhD, Department of Orthodontics and Oral Biology, University Medical Centers, Nijmegen, the Netherlands. M. A. van't Hof, PhD, Department of Orthodontics and Oral Biology, University Medical Center, Nijmegen, the Netherlands. E.N. Kikwilu, DDS, M. Dent., Senior Lecturer, Department of Preventive and Community Dentistry, Faculty of Dentistry, Muhimbili University College of Health Sciences, Dar es Salaam, Tanzania.

Request for reprints to: Prof. A.M. Kuijpers-Jagtman, DDS PhD, Department of Orthodontics and Oral Biology, University Medical Centre Nijmegen. P.O. Box 9101, 6500 HB Nijmegen, the Netherlands

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E.A. MUGONZIBWA, A.M. KUIJPERS-JAGTMAN, M.A.  
VAN 'T HOF and E.N. KIKWILU

ABSTRACT

**Objective:** To determine the need for orthodontic treatment among Tanzanian Bantu children.

**Design:** Prospective study using dental casts.

**Setting:** Sixteen randomly selected schools from the Ilala district, Dar-es-Salaam, Tanzania.

**Subject:** Six hundred and forty three Tanzania children from an urban district.

**Method:** Dental casts of 643 Tanzanian subjects in age groups 3-5, 6-8, 9-11 and 15-16 years, were assessed using the Index of Orthodontic Treatment Need (IOTN).

**Main Outcome measures:** Need for orthodontic treatment.

**Results:** Aesthetic treatment need (AC grades 8-10) and dental health component (DHC grades 4-5) occurred in 5-15% and 16-36% of the studied children, respectively. The need measured by DHC increased significantly between the two oldest age groups. An absolute need measured by combining AC grades 8-10 and DHC grades 4-5 was found in 3-12% of the subjects and it increased significantly with age ( $p < 0.03$ ). The most prevalent severe occlusal feature placing the children in the great need category was cross bite. While about 3-19% of the children had distal occlusion (Angle's Class II), mesial molar occlusion (Angle's Class III) was rare, occurring in 1-3% of the children.

**Conclusions:** This study provides baseline data on the need for orthodontic treatment among Tanzanian children that may be useful for the public oral health service to determine priority for orthodontic treatment as part of comprehensive child oral health care in Tanzania.

INTRODUCTION

Several studies report the prevalence of malocclusion in Tanzanian children and adults (1-5). In these studies the prevalence of various occlusal irregularities ranged from 0-35%. However, in planning orthodontic care, one should not only consider the prevalence of a disorder, but as importantly, also the need for such care as expressed by an objective index. So far no study has specifically quantified the proportion of subjects in Tanzania that would need orthodontic treatment or would benefit from it. Without a satisfactory estimate of the need for orthodontic treatment, it is difficult to plan an organized orthodontic service which currently does not exist in Tanzania.

The most commonly used index to assess need for orthodontic treatment probably is the Index for Orthodontic Treatment Need (IOTN) which was introduced by Brook and Shaw (6), and modified by Richmond *et al.* (7). According to Brook and Shaw (6), the IOTN ranks malocclusion on the basis of the

significance of various occlusal traits for aesthetic and dental health impairment. Its intention is to identify those individuals who would most likely benefit from orthodontic treatment. The index has gained a wide spread acceptance as a method for grading malocclusion (8-16), and the validity of the index has been established (17-19). The IOTN has been used to estimate need for orthodontic treatment in different populations but only one publication on an African sample could be identified (20).

The aim of the present study was to determine the need for orthodontic treatment among Tanzanian children according to different age groups using the Index of Orthodontic Treatment Need (IOTN).

MATERIALS AND METHODS

**Materials:** The study was carried out on dental casts from 643 Tanzanian children in age groups 3-5, 6-8, 9-11, 15-16 years. The casts were obtained from a random sample of 869 Tanzanian school children. The children were recruited from 16 schools which were randomly selected from the total

of 500 schools from the Ilala district, Dar-es-Salaam. For logistic reasons (finances and transportation) the schools were selected from different parts of the Ilala district covering areas of different socio-economic background in urban and suburban areas. A more detailed description of the sampling procedures for the children has been given elsewhere(21). The Ministry of Education of Tanzania, the City Commission of Dar-es-Salaam as well as the school authorities gave permission to conduct the study in the selected schools while the parents and subjects were informed verbally after which they could decide to participate in the study or not. For 226 children of the original sample of 869 children, no dental cast was available either due to technical problems/poor quality of the casts or because impressions were not taken during data collection. Both drop out reasons were not related to malocclusion. The age and gender distribution of the study subjects is shown in Table 1.

**Methods:** Orthodontic treatment need was assessed on dental casts using the IOTN(6-7). The index incorporates two components: the Aesthetic Component (AC) and the Dental Health Component (DHC). The AC consists of a scale of ten black and white photographs showing different levels of dental attractiveness(22,23). Grade one represents the most and grade 10 the least attractive arrangements of the anterior teeth (figure 1). The DHC of the index records the various occlusal traits of malocclusion. There are five grades ranging from grade one "No need of treatment" to grade five "Very great need". In this study, the DHC was determined on the dental casts using the so called DHC ruler(7).

Molar occlusion according to the Angle classification recorded separately as this occlusal characteristic is not included in the IOTN and it was determined according to the criteria described by Björk *et al.*(24) with slight modifications. Neutral occlusion (Class I) was registered when the mesio-buccal cusp of the maxillary first permanent molar occluded in the mesio-buccal groove of the mandibular first permanent molar. Distal (Class II) or mesial (Class III) occlusion were recorded when there was a deviation of at least one half a cusp width distally or mesially at both sides, otherwise it was considered to be Class I. For the primary dentition, the molar relationship was classified as Class I, II or III when the distal plane of the second primary molars in centric occlusion was straight, or showed a distal or mesial step, respectively(25).

Thorough methodology training for IOTN measurements was done prior to the data collection at both the University of Manchester (United Kingdom) and University of Nijmegen (the Netherlands). Intra-examiner consistency (investigator EAM) for the IOTN was studied using double determinations

from the dental casts of 20 children assessed with an interval of at least 18 days. The inter-examiner reproducibility between investigator EAM and AMKJ was also studied using double determinations from the dental casts of 20 children and expressed as Kappa reliability coefficient(26,27). For molar occlusion, intra-examiner consistency was studied using double determinations from the dental casts of 40 children within a time interval of two weeks. Data entry and analyses were carried out using SPSS/PC+ statistical package(28). Chi-square and logistic regression were used to test various differences and trends between different subgroups. A p-value <0.05 was considered statistically significant.

## RESULTS

Both intra and inter-examiner reproducibility for the AC of the IOTN was excellent with Kappa values ranging from 0.82-0.99 (SE=0.13) and 0.66-0.82 (SE=0.13), respectively(36, 37). For the DHC of the IOTN, both the intra and inter-examiner reproducibility was high with Kappa values ranging from 0.71-0.81 (SE=0.12) and 0.90-0.91 (SE=0.09), respectively. For molar occlusion intra-examiner consistency, a complete agreement was obtained for the two examinations.

The percentage and 95% confidence intervals (CI) of molar occlusion as measured by Angle's classification in different age groups are shown in Table 2. Neutral occlusion (Angle's Class I) was most common in all age groups. Distal molar occlusion was higher among children in the 9-11 years age group than in the other age groups. Mesial molar occlusion (Angle's Class III) was rare in all four age group.

Percentage and 95% confidence intervals (CI) of need for orthodontic treatment according to the AC of the IOTN are presented in Table 3. The moderate/ borderline need significantly decreased with age ( $p<0.001$ ). Need for orthodontic treatment (AC grades 8-10) was low in the youngest age groups.

Table 4 shows the percentage and 95% confidence intervals (CI) for orthodontic treatment need according to DHC of the IOTN. The percentage of children with need (DHC grades 4-5) was low in the youngest age groups. The need for orthodontic treatment significantly increased with age between age groups 9-11 years and 15-16 years ( $p<0.0001$ ).

**Table 1**

*Distribution of subjects according to age and gender*

Age group years	Boys		Girls		Total
	n	%	n	%	n
3- 5	111	55.0	91	45	202
6- 8	76	45.8	90	54.2	166
9- 11	93	51.7	87	48.3	180
15-16	63	66.3	32	33.7	95
Total	343	53.3	300	46.7	643

**Table 2**

*Percentages and 95% confidence intervals (CI) of molar occlusion according to Angle's classification among Tanzanian children in different age groups (n=643)*

Angle's	3-5 year (n=202)			6-8 year (n=166)			9-11 year (n=180)			15-16 year (n=95)		
	n	%	95% CI	n	%	95%CI	n	%	95% CI	n	%	95% CI
I	193	95.5	(93,98)	152	91.6	(87,96)	143	79.4	(74,85)	84	88.4	(82,95)
II	7	3.5	(1,7)	12	7.2	(4,12)	34	18.9	(13,25)	8	8.4	(3,14)
III	2	1.0	(0,4)	2	1.2	(0,4)	3	1.7	(0,4)	3	3.2	(0,7)

**Table 3**

*Percentages and 95% confidence intervals (CI) of need for orthodontic treatment among Tanzania children according to the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN) (n=643)*

AC grades	Orthodontic treatment need	3-5 year (n=202)			6-8 year (n=166)			9-11 year (n=180)			15-16 year (n=95)		
		n	%	95%CI	n	%	95%CI	n	%	95% CI	n	%	95% CI
1-4	No/slight need	75	37.1	(31,44)	62	37.3	(30,45)	83	46.1	(39,53)	55	57.9	(48,68)
5-7	Moderate/ borderline need	117	57.9	(51,65)	80	48.2	(41,56)	75	41.7	(34,49)	28	29.5	(20,39)
8-10	Need	10	5.0	(2,9)	24	14.5	(9,20)	22	12.2	(7,17)	12	12.6	(6,19)

**Table 4**

*Percentages and 95% confidence intervals (CI) of need for orthodontic treatment among Tanzania, children according to the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN) (n=643)*

DHC grades	Orthodontic Treatment need	3-5 year (n=202)			6-8 year (n=166)			9-11 year (n=180)			15-16 year (n=95)		
		n	%	95%CI	n	%	95%CI	n	%	95% CI	n	%	95%CI
1	No need	116	57.4	(51,64)	54	32.5	(25,40)	44	24.4	(18,31)	32	33.7	(24,43)
2	Little need	14	6.9	(4,12)	19	11.4	(7,16)	24	13.3	(8,18)	4	4.2	(0,8)
3	Borderline	40	19.8	(14,25)	58	34.9	(28,42)	72	40.0	(33,47)	25	26.3	(18,35)
4	Need	30	14.9	(10,20)	35	21.1	(15,27)	32	17.8	(12,23)	28	29.5	(20,39)
5	Great Need	2	1.0	(0,4)	0	0	(0,2)	8	4.4	(2,7)	6	6.3	(1,11)

• Significant different for the need DHC grades(4-5) of orthodontic treatment between the two oldest groups (P<0.0001)

**Table 5**

*Percentages and 95% confidence intervals (CI) of need for orthodontic treatment according to DHC subcategory letters in children with great need of orthodontic treatment (DHC grades 4-5)*

DHC subcategory	3-5 year (n=32)			6-8 Year (n=35)			9-11 year (n=40)			15-16 years (n=34)		
	n	%	95%CI	n	%	95% CI	n	%	95% CI	n	%	95%CI
a	2	6.3	(1,21)	4	11.4	(3,27)	6	15.0	(6,30)	3	8.8	(2,24)
c	21	65.6	(47,81)	24	68.6	(51,83)	21	52.5	(36,68)	13	38.2	(22,56)
d	0	0	(0,11)	2	5.7	(1,19)	5	12.5	(4,27)	3	8.8	(2,24)
e	5	15.6	(5,33)	5	14.3	(5,30)	0	0	(0,9)	3	8.8	(2,24)
h	0	0	(0,11)	0	0	(0,10)	0	0	(0,9)	1	2.9	(0,15)
i	2	6.3	(1,21)	0	0	(0,10)	8	20.0	(9,36)	5	14.7	(5,31)
m	2	6.3	(1,21)	0	0	(0,10)	0	0	(0,9)	0	0	(0,10)
t	0	0	(0,11)	0	0	(0,10)	0	0	(0,9)	6	17.6	(7,35)

a = Increased overjet

c = Anterior/posterior crossbite  
 d = Contact point displacement  
 e = Open bite  
 h = Extensive hypodontia with restorative implications  
 i = Impeded eruption of teeth  
 m = Reverse overjet with recorded masticatory and speech difficulties  
 t = Partially erupted teeth, tipped and impacted against adjacent teeth.

### Figure 1

*The aesthetic component of IOTN for dental cast use (Richmond et al. 1992)*

When need for treatment based on AC (grade 8-10) and DHC (4-5) were combined, 3.5%, 8.4%, 10% and 11.6% of the children in the ascending age groups, respectively had an absolute need for orthodontic treatment. When subjected to logistic regression analysis, the need showed to increase with age ( $p=0.03$ ).

The percentage and 95% confidence intervals (CI) of need for orthodontic treatment according to DHC subcategories in children with need of orthodontic treatment (DHC grades 4-5), are presented in Table 5. The most prevalent severe occlusal feature placing the children in all age groups in the need category was cross bite, 38-69%. Open bite was the next most common in the youngest two age groups with a prevalence of about 14-16% among children in need of treatment. In age group nine and half to eleven years impeded eruption of teeth (20%) was the second most prevalent severe occlusal feature followed by increased overjet greater than six millimeters (15.0%) and contact point displacements of more than four millimeters (12.5%). In the oldest age group, crowding (DHC d and t) was the second most prevalent severe occlusal feature occurring in about 26% of the children and followed by impeded eruption of teeth which was found in about 15% of the subjects.

### DISCUSSION

The high prevalence of neutral occlusion among the subjects in this study is in agreement with findings reported previously on early, late mixed and permanent dentitions of Tanzanian children(2,29). Studies

comparing African, African American and Caucasian children have shown that the first two have sagittally less often distal occlusion and more often neutral (2,29-32) and mesial occlusions(30-32), than Caucasians. The present results probably confirm the basic structural differences in the sagittal skeletal relationship(33) between Tanzanian and Caucasian children.

In this study, the need for orthodontic treatment was determined in a sample of Tanzanian children who never had orthodontic treatment. The borderline need (AC grades 5-7) for orthodontic treatment had a tendency to decrease with age probably indicating that the aesthetics improves with development of the dentition. The real aesthetic need (AC grades 8-10) for orthodontic treatment was almost stable from age group six and half to eight years to fifteen to sixteen years. The consistency of the proportions of children with need (AC grades 8-10) may reflect the strength of AC of the IOTN when taking into account the developmental changes that are occurring during the three age groups. The aesthetic need (AC grades 8-10) for orthodontic treatment of 12-15% in the oldest two age groups in the present study was slightly higher compared to 7% reported in the Nigerian children (20). On comparison with studies from elsewhere using the same index, the aesthetic need (AC grades 8-10) in our study was higher than 0.5-5% reported in British and Turkish children(6,9,34). However, Burden (35) reported 36% of the British children having need (AC grades 8-10) for orthodontic treatment in a large sample of 1137 children aged 11-12 years.

About 16-36% of the children had severe irregular teeth with DHC grades four to five increasing significantly between the two oldest age groups. Cooper *et al.*(36) using the IOTN among 11 to 16 year old children reported that the DHC of the IOTN showed consistency over time despite temporal changes in the various occlusal traits that comprise the index. On the other hand our findings are comparable to other reports using the IOTN (9, 20, 37, 38).

The need (DHC grades 4-5) of orthodontic treatment in the oldest two age groups in our study was higher compared to the need of about 13% that was reported in the Nigerian African children aged 12-18 years (20). When Proffit *et al.*(39), applied the IOTN index on a large American epidemiological database, 13% and 22% of the American-African children aged 8-11 and 12-17 years respectively, were found with need (DHC grades 4-5) of orthodontic treatment also being slightly lower compared to the results in the present study. This discrepancy may be attributed to the way the IOTN was used in the American study. However, the results in the present study were comparable to previous studies using DHC of the IOTN which reported a need (DHC grades 4-5) of orthodontic treatment to vary from 10 to 39% among children aged 8-12 years (6, 8, 9, 14, 34, 35, 38-41).

In this study, more children had malocclusions indicating definite need for orthodontic treatment according to DHC than the AC impairment. A combination of the index components (AC grades 8-10 and DHC grades 4-5) showed that about 3-12% of the children absolutely had a need for orthodontic treatment increasing with age. These results were within the range of absolute need reported in the Nigerian study (20).

The results showed that the main severe occlusal feature which was responsible for allocation of children into the category of need (DHC 4-5) for orthodontic treatment was cross bites in all age groups. However, the number of children with cross bite (DHC subcategory 4c) probably was overestimated due to the method. According to the original IOTN protocol for recording of cross bites on dental casts, a discrepancy between retruded contact position and intercuspal position of greater than two mm is assumed to be present and grade 4c recorded(7). Other occlusal features were open bites of more than four millimeters in youngest two age groups, impeded emergence of teeth and increased overjet greater than six millimeters in the nine and half to eleven years old age group and crowding (DHC d and t) and impeded emergence of teeth in the oldest age group. The proportions for impeded eruption of teeth has to be looked at cautiously as teeth could be missing for other non-orthodontic reasons.

In summary, the results of the present study showed that need for orthodontic treatment among Tanzanian children is comparable to other populations. In Tanzania there are no trained orthodontists while the

number of children aged five to nineteen years comprises 39.6% of an estimated 36.6 million Tanzanian population(42). This study provides baseline data that may be useful for the public oral health service to determine priority for orthodontic treatment as part of comprehensive child oral health care in Tanzania. As IOTN is not a measure of orthodontic treatment demand, further research is needed to determine the demand for orthodontic treatment in the Tanzanian society. Because of possible variation in occlusal conditions between urban and rural populations, it is suggested that a similar study should be done to assess the need for orthodontic treatment in the Tanzanian rural settings.

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