Biometrics of the primary dentition in a Nigerian sample

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Abstract

Objective: The purpose of this study was to determine normative values of crown dimensions, arch dimensions, and amount of interdental space in the primary dentition of Nigerian children.
Method: Dental casts from alginate impressions obtained from 125 randomly selected nursery school children (65 boys, 60 girls) aged 3 to 5 years, were measured with electronic caliper. Independent t tests were used to analyze sample differences between sexes.
Result: There were significant gender differences in arch width, depth and length dimensions, with the exception of the left mandibular anterior length. The boys showed significantly larger mesiodistal crown dimensions, except in the maxillary and mandibular primary lateral incisors. Gender differences in buccolingual crown diameters were statistically significant for maxillary second primary molars. There was no significant gender difference in amount of interdental spaces.
Conclusion: It can be concluded that males had larger tooth/arch dimensions than females in the primary dentition stage.

Key words: Biometric, dental, arch, primary dentition, Nigerian

Introduction

The biometrics of the primary dental arches serves as an important baseline for studying the growth and development of the human dentition and occlusion. The dental arch can be grouped into various segments: incisor, canine, and molar segments, which play a significant role in determining the space and occlusion in the permanent dentition[1]. It is generally agreed that the mesiodistal crown width and occlusion in the primary dentition play a significant role in determining space and occlusion in the permanent dentition[2]. Spacing is often present between all anterior primary teeth with the most marked spaces present mesial to canines in the maxilla and distal to canines in the mandible. These are called primate or anthropoid spaces[3]. Another type of spacing in the primary dentition is the secondary or the developmental spaces, which are usually found between the incisors[4]. These spaces are later very important to the alignment of erupting permanent teeth and establishment of occlusion[3]. Previous epidemiological studies suggest population differences in tooth size and arch dimensions [5,6]. This has been related to complex interaction between genetic and environmental factors[7]. Sexual dimorphism in tooth size has also been reported in the primary dentition[8]. Biometric evaluation of the primary dentition has been limited largely to populations of European[9], European American[10], Arab[11], and African American[5] descents. Little is known regarding the biometric dimensions of the primary dentition of children of Nigerian origin[12].
The aim of this study was to determine normative dental arch dimensions (arch length, arch width, arch depth, and amount of interdental space) and tooth dimensions (mesiodistal and buccolingual) in the primary dentition of Nigerian children; and to establish sexual dimorphism, if any, among the population.

Materials and method

Sample Selection
Study groups were selected from primary schools in Lagos State, in the South West of Nigeria. Lagos State is a metropolitan state whose population consists of diverse ethnic groups and foreigners with associated inter-ethnic and mixed marriages. Three local government areas (LGAs) of the 20 LGAs in the State were selected for the study. The second stage was the selection of 15 schools within the selected LGAs, while the third stage was the selection of 384 children of Nigerian origin aged 3 to 5 years from the sampled schools. They were informed of the procedures at each stage and consented to the procedure in question, whether history-taking and examination, or impression-taking. Permission for the investigation was given by the relevant authorities for ethics (Research and Ethics Committee of Lagos University Teaching Hospital, Nigeria).

History - taking
Detailed dental and medical histories were taken. These included past dental and surgical treatments, history of digit and other oral habits, and previous orthodontic treatment.

Clinical Examination
All participants were examined by the same clinician. The children were examined in the classroom under natural lighting. Participants were included if they were Nigerians, apparently healthy and lacking any congenital malformations, had complete primary dentition with no erupted permanent teeth.

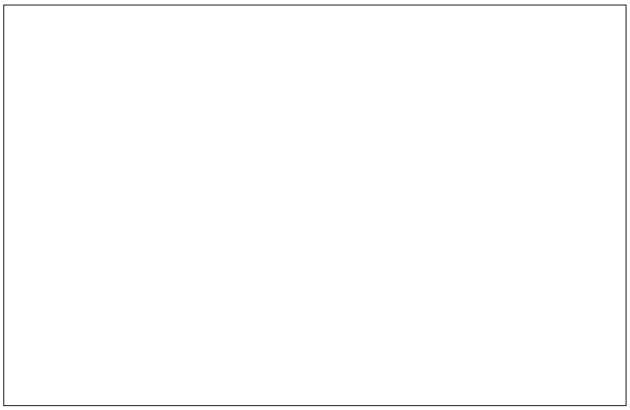

Figure 1- Electronic digital caliper

Figure 2 - Landmarks for arch width measurements

Figure 3- Landmarks for arch depth measurements

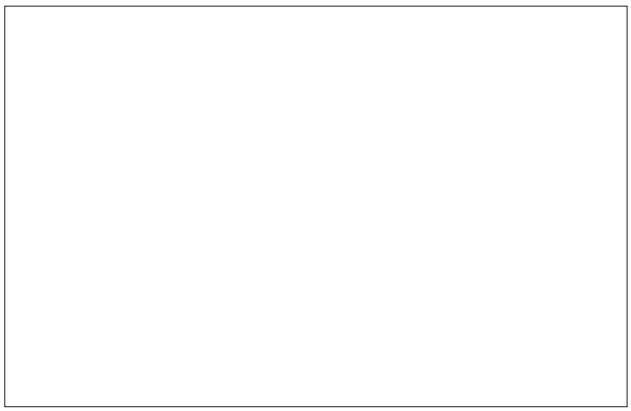

Figure 4 - Landmarks for arch length measurements.
A = Anterior segment (right), B = Posterior segment (right),
C = Anterior segment (left), D = Posterior segment (left).

Impression – taking
Impressions for all participants were made in alginate impression material. These impressions were cast immediately in dental stone to prevent dimensional changes.

Dental Cast Selection
Dental cast selection criteria excluded primary dentition with (1) extracted or congenitally missing teeth (2) major tooth destruction or restorations (3) clinical history of oral habits (4) history of orthodontic treatment. Measurements on some dental casts could not be obtained due to defective models. A total sample of 125 children (65 boys, 60 girls) was eventually included in the study.

Reference Points, Measuring Technique, and Measurement Error
The biometric data for arch length, arch width, arch depth, interdental space, mesiodistal and buccolingual tooth dimensions were obtained from dental casts. The models were numbered for easy identification and measurements were carried out (Figure 1) using an electronic digital caliper (Mitutoyo Corp, Tokyo, Japan) (Figure 1).

The various measurements made on primary teeth are as follows

1. Mesiodistal crown width was measured as the greatest distance between the mesial and distal surfaces of the crown, parallel to the occlusal surface.
2. Buccolingual crown width was measured as the greatest distance between the buccal and lingual surfaces of the crown.
3. Width of the spaces was measured using electronic caliper with the caliper's ends held parallel to the occlusal plane cervical to the contact points.
4. Intercanine width was measured from the cusp tip of the canine on one side to the cusp tip on the other side (Figure 2).
5. Intermolar width was measured from the mesiobuccal cusp tip of the second molar on one side to the mesiobuccal cusp tip of the second molar on the other side (Figure 2).
6. Arch depth was measured from a line passing through the midpoint between the distal surfaces of the primary second molar to a midpoint between the central

incisors (Figure 3).
7. Anterior segment length was measured from the distal contact point of the canine to the midpoint between the incisors (Figure 4).
8. Posterior segment length was measured from the most distal point on the crown of the second molar to the distal contact point of the canine (Figure 4).

Repeatability test was done by randomly selecting five dental casts from boys and five from the girls (20 models). All the twenty casts were remeasured to assess the examiner's reliability for the variables. Intraclass correlation coefficient was used to assess the consistency or agreement of values within cases for repeatability, and it showed a statistically significant consistency or agreement of values within cases for all the parameters estimated ($r > 0.93$; $P < 0.0001$).

Statistical Analysis
Data were collated and entered onto an Excel™ chart. Statistical Package for Social Sciences (SPSS) for Windows 2000, version 10 was used for statistics, i.e mean, standard deviation, t-test analyses. The level of statistical significance was predetermined at a probability value of < 0.05.

Results

One hundred and twenty-five subjects comprised of 65 males and 60 females, aged 3 - 5 years (mean 4.19 ± 0.74 years) participated in the study.
A difference of less than 0.5mm was found, comparing mesiodistal width, buccolingual width and interdental spaces on both sides of the arches. As no significant difference was detected in the widths of teeth and interdental spaces on the two sides in our sample, the average width of each tooth and space (right + left 2) was calculated and recorded. Primate space showed a significant predilection ($P < 0.05$) for the maxilla (97.2%) compared with the mandible (81.6%). The total amount of interdental space in the respective dental arches of boys and girls was almost equal. No sex differences were observed in the pattern of interdental space distribution within the dental arches (Table 1). The absence of developmental spaces was observed in 10.8% of the boys and 8.3% of the girls in the maxilla, and 9.2% of the boys and

Table 1: Dimensions (mm)of the interdental spaces in the primary dentition in Nigerian children

	Maxilla			Mandible		
	Male (n = 65)	Female (n = 60)		Male (n = 65)	Female (n = 60)	
Site	Mean (SD)	Mean (SD)	p value	Mean (SD)	Mean (SD)	p value
A - A[a]	0.49 (0.84)	0.74 (1.02)	0.140	0.72 (0.65)	0.75 (0.71)	0.808
A - B	0.60 (0.54)	0.56 (0.41)	0.645	0.58 (0.61)	0.54 (0.49)	0.711
B - C	1.23 (0.74)	1.01 (0.53)	0.060	0.49 (0.43)	0.48 (0.34)	0.472
C - D	0.30 (0.38)	0.32 (0.42)	0.762	0.49 (0.51)	0.48 (0.36)	0.510

[a] Palmer system of tooth notation; SD = Standard deviation

Table 2. Mesiodistal tooth width (mm) of Nigerian children in primary dentition

	Maxilla			Mandible		
	Male (n = 65)	Female (n = 60)		Male (n = 65)	Female (n = 60)	
Tooth	Mean (SD)	Mean (SD)	p value	Mean (SD)	Mean (SD)	p value
A[a]	6.95 (0.42)	6.67 (0.41)	0.000***	4.21 (0.33)	4.09 (0.32)	0.040*
B	5.68 (0.40)	5.57 (0.45)	0.163	4.71 (0.42)	4.68 (0.34)	0.729
C	6.89 (0.38)	6.69 (0.41)	0.006**	6.07 (0.37)	5.93 (0.36)	0.030*
D	7.80 (0.54)	7.49 (0.51)	0.001**	8.40 (0.56)	8.03 (0.45)	0.000***
E	9.57 (0.61)	9.28 (0.66)	0.011*	10.56 (0.60)	10.24 (0.51)	0.002**

* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$; [a] = Palmer system of tooth notation; SD = Standard deviation

Table 3. Buccolingual tooth width (mm) of Nigerian children in primary dentition

	Maxilla			Mandible		
	Male (n = 65)	Female (n = 60)		Male (n = 65)	Female (n = 60)	
Tooth	Mean (SD)	Mean (SD)	p value	Mean (SD)	Mean (SD)	p value
Aa	5.22 (0.39)	5.07 (0.49)	0.062	3.93 (0.34)	3.81 (0.42)	0.078
B	4.76 (0.41)	4.69 (0.46)	0.369	4.28 (0.34)	4.17 (0.39)	0.101
C	6.04 (0.45)	5.89 (0.42)	0.055	5.38 (0.45)	5.31 (0.37)	0.343
D	8.85 (0.50)	8.68 (0.53)	0.064	7.28 (0.48)	7.15 (0.41)	0.154
E	9.82 (0.60)	9.52 (0.50)	0.003**	8.42 (0.51)	8.30 (0.44)	0.155

** = P < 0.01; [a] = Palmer system tooth notation; SD = Standard deviation

Table 4. Dimensions of the dental arch (mm) in the primary dentition in Nigerian children.

	Maxilla			Mandible		
	Male (n = 65)	Female (n = 60)		Male (n = 65)	Female (n = 60)	
Variable	Mean (SD)	Mean (SD)	p value	Mean (SD)	Mean (SD)	p value
Intercanine width	32.77 (1.65)	31.88 (1.37)	0.001**	25.22 (1.56)	24.48 (1.59)	0.010*
Intermolar width	47.66 (1.87)	45.98 (1.55)	0.000***	40.25 (1.72)	39.13 (1.52)	0.000***
Arch depth	29.75 (1.66)	29.02 (2.22)	0.038*	27.10 (2.11)	25.88 (1.52)	0.001**
Anterior segment (R)	21.66 (1.40)	21.08 (1.34)	0.019*	16.48 (1.05)	15.98 (0.98)	0.007**
Posterior segment (R)	18.12 (1.03)	17.66 (1.09)	0.018*	19.87 (0.98)	19.11 (0.97)	0.000***
Anterior segment (L)	21.22 (1.26)	20.63 (1.06)	0.005**	16.01 (1.09)	15.64 (1.01)	0.052
Posterior segment (L)	18.07 (1.03)	17.56 (0.99)	0.006**	19.86 (1.07)	19.14 (0.93)	0.000***

* = P < 0.05; ** = P < 0.01; *** = P < 0.001; R = right; L = left; SD = Standard deviation

8.3% of the girls in the mandible. There were no spaces observed in this study between first and second primary molars.

The mesiodistal width of primary teeth in males was larger than the corresponding teeth in females (Table 2). However there was no statistically significant difference in mesiodistal crown diameters of primary lateral incisor teeth between males and females. No statistically significant difference was detected in buccolingual width of teeth between males and females (Table 3), with the exception of maxillary second primary molars (P < 0.01).

Boys showed larger biometric values for each of the respective arch dimensions compared with girls (Table 4). Gender dimorphism was statistically significant (range of P = 0.038 to P < 0.001) for each arch dimension except for the mandibular left anterior segment (P = 0.052).

Discussion

This investigation has established normative values for arch and tooth diameters of primary teeth in a Nigerian population. Dental arch dimensions and spacing in primary dentition determine to a large extent the alignment of teeth in permanent dentition. After the complete eruption of primary dentition by the age of three, the entire arch and occlusion is relatively stable for the next two years. During this static period, if proper prediction of arch changes and occlusion are done by the Paediatric dentist, it helps in establishing an acceptable aesthetic and functional occlusion at a later stage[1]. Therefore the present study considered these particular age groups of 3 to 5 years. Although measurements on dental casts are reported to be on average 0.1mm larger than those of the actual teeth, dental cast measurements seem more reliable than those made directly in the mouth[13]. Therefore analysis of study models seems appropriate to this form of investigation.

The mean mesiodistal tooth diameters for both sexes in this study were bigger than those reported for Jordanian children[11] and Egyptian children;[14] but were smaller than those reported for Australian Aborigines[15]. The results on sexual dimorphism in mesiodistal tooth width revealed that males exhibited larger dimensions than females, and were consistent with those reported for other populations for some primary tooth types[8, 11, 16].

The results on gender dimorphism in dental arch dimensions were consistent with previous reports[11, 17]. Although a higher mean arch dimensions were reported for

males than that of female Indian children,[1] some of the parameters showed a lack of statistical significance, which was not consistent with our studies. The difference in significance could be due to the difference in the measurement techniques. In this study, the anterior segment was measured to include the canine segment whereas in the study conducted on the Indian children, the canine segment was measured as a separate parameter. Also, the mesiobuccal cusp of the second primary molar was used as a landmark for intermolar width in our study, whereas the central fossa of the second primary molar was used in the study conducted on the Indian children.

The lack of spaces observed in this study between first and second primary molars differ from observations of spaces between first and second primary molars in 3-4-year-old Nigerian children[12]. It was proposed that spaces between first and second primary molars disappear between 2.5 and 3.5 years of age, especially in the mandible. In the present study, the average primate space in males (both sides combined) was 1.23 mm and 0.49 mm in upper and lower arches, respectively. In females, 1.01 mm and 0.48 mm in upper and lower arch, respectively. This is lower than the corresponding primate space width in Egyptian children in which 2.56 mm was reported in the upper arch and 1.57 mm in the lower arch[14]. This study also showed no gender dimorphism in interdental spaces. This is not consistent with previous studies in a Jordanian sample where primate spaces were reported to be larger in males than in females[11].

The present study provided an insight into the state of dentition and dental arch dimensions, and spacing in the primary dentition in Nigerian children. Further longitudinal studies are necessary to follow the tooth and dental arch dimensions from the primary to the mixed dentition period.

Conclusion

In this study, males had larger tooth-arch dimensions than females in the primary dentition stage.

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