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Perioral Anthropometric Indices: Its Relevance in Reconstructive Surgery

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Abstract

Background: The perioral region plays an important role in facial recognition, gender classification, esthetics, facial expression, speech and eating. ***Aim:*** To establish normative perioral data for South-East, Nigerian children ***Methods:*** A sample of 120 healthy subjects within the age range of 1 to 5 years were enrolled in this study. Two dimensional photographs of the face were captured non-invasively using a Nikon D 90 camera, ten perioral landmarks were identified and four indices deduced ***Results:*** It was observed that vertical mouth height index, upper lip thickness and lip index in the males showed higher values when compared to the females which indicates sexual dimorphism ($P \leq 0.05$). Most children in our cohort were classified as having a thick lip index, mouth of intermediate height in relation to the height of the face, thick upper and lower lip thickness index, narrow mouth in relation to the width of the eyes. The mean values of Vermillion height of Lower lip and Lower Lip Thickness Index was also observed to be consistently higher when compared to upper lip in both sexes. ***Conclusion*:** The study presents a primary data base for perioral anthropometric indices of children in South-East Nigerian which can aid ethnic specific postoperative evaluation of congenital or post-traumatic orofacial reconstructive surgeries.

Keywords: Children, Perioral, Reconstructive Surgery, Anthropometry.

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INTRODUCTION

The lips are an essential component of the symmetry and aesthetics of the face (Kar *et al.*, 2018). Research on lip indices, morphology, aesthetics and labial–facial relationships could provide a basic theory to support diagnosis and treatment protocols in orofacial anomalies and evaluative criteria for treatment and surgical improvements (Wu *et al.*, 2019).

Labial dimensions are subject to age variations (Sforza *et al.*, 2010) gender and ethnic inclination (Berkovitz and Standerij 2005). In the management of cleft lip and palate, data about the growth rate of the craniofacial skeleton and facial soft tissues are important in determining the accurate time for correcting of facial deformation (Berkovitz and Standerij 2005). Hence specific normative data are needed in planning surgical interventions in the orolabial region (Raschke *et al.*, 2012, Jayaratne *et al.*, 2013).

Studies have been carried out in Nigeria to develop normative values (Ajayi, 2004). These studies have however been restricted to dentoskeletal relationships with little emphasis on soft tissue profile. Thus, there is need to develop baseline perioral parameters as a surgeons precision tool to aid clinical diagnosis and treatment in orofacial reconstructive surgeries for South-East Nigerian's children.

MATERIALS AND METHODS

Image J software developed at the National Institutes of Health and the Laboratory for Optical and Computational Instrumentation (LOCI, University of Wisconsin), Nikon D90 digital single lens reflex camera (Nikon, Thailand August 27, 2008), Tripod stand, Self - adhesive stickers (4.5cm).

Subjects

The study group consisted of 120 apparently healthy children with no history of orofacial surgery

within the age range of 1-5 years in South -East Nigeria.

Ethical Consideration/Consent

The study was reviewed and approved by the Ethical Clearance Committee of Faculty of Basic Medical Sciences**,** Enugu State University of Science and Technology (ESUT) Enugu**,** Nigeria with clearance certificate number ESUCOM/FBMS/ETR/2021/009. Informed consents were obtained from guardians /parents of selected subjects in accordance with ethical guidelines of the Helsinki declaration of 1975 as revised in 2013.

Inclusion Criteria

Children within the age group of 1-5 years who had no previous history of facial surgeries were recruited for this study. Children who met the inclusion criteria were randomly selected using purposive convenient sampling technique.

Methods

Pre-image acquisition:

Subjects**'** Age and Sex were recorded along with identification numbers in our data proforma before photographs were taken. The identification numbers were duplicated on self-adhesive tags of known length (4.5cm) for ease of conversion to real life measurements (Ozioko *et al.,* 2020).

Image Acquisition

Images were acquired using Nikon D9O digital single lens reflex camera. Camera settings were adjusted to 12.3 mega pixel, 600Dpi resolution, fixed focal length of 90 to150mm, high quality macro lens (to assure maximum depth of field)**,** high aperture setting (f>16) and exposure time (>125 milli sec). Each subject were positioned on a line marked 100cm from the camera (Ozioko *et al.,* 2020) and photos were taken parallel to the subject's 100cm mark to reduce image perspective distortion.

Methodology of Measurement

Landmarks were tagged on photographs as enumerated and measured using Image J software.

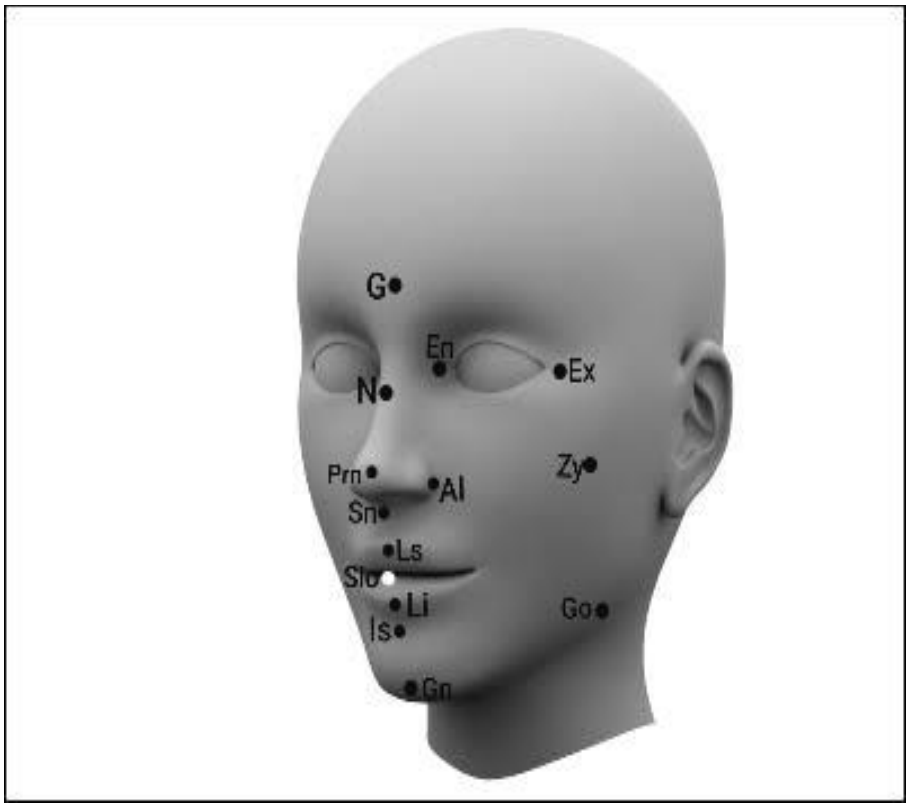

Fig I: Facial landmarks

Face length: Nasion -Gnathion (Roelofse *et al.,* 2008).
Outer canthal distance: Exocathion-exocathion (Roelofse *et al.,* 2008).
Vertical height of lip: Columellar base to cupid's bow peak (Chakravarthy, 2016).
Vermillion height of lower lip: Labiale inferius – stomium (Chakravarthy, 2016)
Vermillion height of upper lip: Labiale superius – stomium (Chakravarthy, 2016)
Total vermillion height: Labiale superius -Labiale inferius (Chakravarthy, 2016)
Outer commissural width: Cheilon-cheilon (Chakravarthy, 2016)

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Length from tip of cupid bow to commissure (Cho *et al.*, 2006)
Width of one limb of cupid bow (Cho *et al.*, 2006)
Length from alar base to central columellar (Cho *et al.*, 2006)
Length from alar base to commissure: (Zhu *et al.*, 2008)
Nose width: Alar-Alar (Júnior *et al.*, 2016)
Lip index: 100*ls-li/ch-ch (Roelofse *et al.*, 2008)
Vertical mouth height index: 100*ls-li/gn-n (Roelofse *et al.*, 2008)
Upper lip thickness index: 100*ls-li/gn-n (Roelofse *et al.*, 2008)
Lower lip thickness index: 100*li-sto/ls-li (Roelofse *et al.*, 2008)
Mouth width index: ch-ch/ex-ex * 100 (Roelofse *et al.*, 2008)

Using the exported data, anthropometric indices (Lip index, Vertical mouth height index, Upper lip thickness index, Lower lip thickness index, Mouth width index) was calculated The ranges of each index were then used to classify the features into different morphological categories. Gender differences were explored using Student's t test with the alpha level set at 0.05. All statistical analysis were performed with the aid of Statistical Package for the Social Sciences **v**ersion 23 presented as mean±standard deviation and *P*-value < 0.05 was considered statistically significant.

Table 1: Descriptive Statistics of Perioral Parameters in Relation to Sex (1-5 years)

Parameter(cm)	Male Mean ±SD	Female Mean ±SD	P-value
Face length	**7.59±0.67**	**7.87±0.81**	**0.071**
Vertical height of lip	**1.12±0.23**	**1.11±0.19**	**0.046***
Vermillion height of lower lip	**1.02±0.22**	**1.03±0.21**	**0.669**
Vermillion height of upper lip	**0.78±0.20**	**0.81±0.17**	**0.862**
Total vermillion height	**1.70±0.37**	**1.81±0.34**	**0.401**
Outer commissural width	**3.17±0.46**	**3.35±0.48**	**0.995**
Length from tip of cupid bow to commissure	**1.56±0.29**	**1.61±0.27**	**0.448**
Length from alar base to central columellar	**1.30±0.26**	**1.45±1.91**	**0.308**
Width of one limb of cupid bow	**0.42±0.08**	**0.44±0.18**	**0.179**
Nose width	**2.73±0.35**	**2.88±0.29**	**0.282**
Lip index	**53.92±10.66**	**54.30±8.68**	**0.906**
Vertical mouth height index	**22.42±4.83**	**23.08±3.10**	**0.577**
Upper lip thickness index	**47.96±25.06**	**45.11±6.61**	**0.572**
Lower lip thickness index	**61.36±15.41**	**57.18±9.1**	**0.512**
Mouth width index	**42.50±5.97**	**44.19±6.24**	**0.449**

Data was analyzed using the t-test for independent samples between sexes on both sides (Table 1) It was observed that there is statistical significant difference in the vertical height of lip ($P< 0.05$) between sexes.

Table 2: Distribution of Indices in Relation to Sex

Distribution of Lip Index in Relation to Sex						
Gender	**Thin< 34.9**	**Intermediate 35-44.9**	**Thick .>45**	**Total**	**Fisher's exact**	**P-value**
Male	1(0.8%)	7(5.8%)	74(61.2%)	**120(100%)**	5.940	0.034
Female	0(0.0%)	10(8.3%)	29(24.0%)			
Vertical Mouth Height Index						
Gender	**Thin < 15.9**	**Intermediate 16-22**	**Thick > 22.1**	**Total**	**X^2**	**P-value**
Male	**6(5.0%)**	**53(43.8%)**	**23(19.0%)**	**120(100%)**	**2.355**	**0.308**
Female	**3(2.5%)**	**30(24.8%)**	**6(5.0%)**			
Upper Lip Thickness Index						
Gender	**Thin**	**Intermediate**	**Thick**	**Total**	**X^2**	**P-value**
Male	4(3.3%)	25(20.7%)	53(43.8%)	120(100%)	2.152	0.341
Female	1(0.8%)	17(14.0%)	21(17.4%)			
Lower Lip Thickness Index						
Gender	**Thin**	**Intermediate**	**Thick**	**Total**	**X^2**	**P-value**
Male	2(1.7%)	27(22.3%)	53(43.8%)	120(100%)	4.400	0.11
Female	2(1.7%)	6(5.0%)	31(25.6%)			

Lip index is used to calculate the relationship between the height (thickness of the lips and the breadth of the mouth). The height of the lips (ls-li) is divided by the breadth of the mouth (ch-ch) and shown as a

percentage. Table 2 shows that most males and females in our cohort were classified as having a thick lip index while the least prevalent lip index category was observed to be thin lip index in both Sex. Significant difference in the lip index in relation to sex (P>0.05) was also observed.

The relationship between the height of both the lips (ls-li) and the morphological height of the face (gn-n) was calculated with this index. From the table, it can be seen that most of the children in our cohort was classified as having a mouth of intermediate height in relation to the height of the face, while the least prevalent lip index category was observed to be thin lip index in both Sex.

The thickness of the upper lip in relation to the height of the mouth was studied using this index .as seen from table shows that most children in our cohort were classified as having a thick upper lip thickness index, while the least prevalent index category was observed to be thin upper lip thickness index in both Sex.

This index was used to calculate the relationship between the thickness of the lower lip (li-sto) and the height of both lips (ls-li). The index shows how much the lower lip contributes to the height of the whole mouth. The majority of the children in our cohort were classified as having a thick lower lip thickness index, while thin lower lip thickness index in both Sex was observed to be the least prevalent.

DISCUSSION

The lower one third of the face has a major impact on the perception of facial aesthetics (Anic-Milosevic *et al.,* 2010). The size and curvature of the exposed red lip surface is subject to sex and ethnic variation (Sforza *et al.,* 2010). A few studies have been conducted on lip anthropometry in different populations (Upadhyay *et al.,* 2013). However, there is paucity of data on lip anthropometry of Nigerian children.

In the lower lip the junction of the skin and the red lip area varies greatly in different individuals (Ellis and Moore 2002). The lower lip is usually larger than the upper lip vertically (Kar *et al.,* 2018). This concurs with the results of the present study (Table 1) where the mean values of Vermillion Height of Lower lip and Lower Lip Thickness Indices were consistently higher when compared to the upper lip indices in both sexes.

In the present study (Table 1), it was also observed that vertical mouth height indices, upper lip thickness and lip indices were indicators for sexual dimorphism (males showed higher values when compared to females). This result supports the findings that sexual dimorphism does exist and showed statistical significance between sexes ($P< 0.05$). This is in consistency with the previous studies of (Jayaratne *et al.,* 2013; Zhu *et al.,* 2008; Upadhyay *et al.,* 2013; Isiekwe, 2012)

In contrast Chakravathy *et al.,* (2016) in his Indian American study reported no statistical significant sexual difference in vermillion height of upper lip in his cohort.

Anthropometric ratios are crucial in the assessment of orofacial cleft and a ratio significantly above the normal has been considered potentially unattractive (Vegter *et al,* 1997). Kanju *et al.,* (2006) suggested that the aesthetic standards of a particular group may not suit other patients belonging to diverse racial and ethnic background. These findings suggest that our data will help correct the discrepancy of using other population anthropometric indices for cosmetic surgeries.

In the present study, (Table 2) most children in our cohort had thick lip index, mouth of intermediate height in relation to the height of the face, thick upper and lower lip thickness index. In particular, taking the esthetic characteristics of the mouth area into consideration, proper relationships between the cutaneous and vermilion parts of the lips should be maintained or restored via maxillofacial reconstructive surgeries (Gibelli *et al.,* 2015).

Majority of data published in the international literature are for young adults hence the data of our study were compared with the few available reference values. The mean value range for outer commissural width in the present study was 27.9 ± 0.26mm (males) and 28.7 ± 0.39mm (females), which is lower compared to 39.07±40.1mm (males) and 38.18±4.83mm (females) reported by Hyekyung *et al.,* 2016. The outer commissural width mean values reported for age range of 1-5 years in the present study is lower than those reported by (Ogodescu *et al.,* 2021) (35.93±34.3 - 44.14±3.93mm) and that reported by (Dolci *et al.,* 2021) (41.3 ±3.3 - 45.7 ± 5.8mm) for 3-11 years Romanian cohort. These implies differences in lip morphometry between races and ethnic groups.

Linear distances, areas and volumes in the orolabial area exhibits distinct patterns during childhood and adolescence. In particular, the dimensions of the labial vermilion undergoes a nearly constant increment; its evaluation might be of help in differentiating the various age groups and age-related trends. This should be properly considered for clinical treatment and planning. These variations could be due to differences in age, sample size, geographical conditions and method of data collection.

Timely Orofacial cleft repair is needful for medical, aesthetic, and psychosocial reasons. Several studies has reported late presentation for corrective surgeries among individuals from developing countries

(Aziz *et al.*, 2009; Singh 2009). To prevent speech impairment, all surgical interventions should be completed before the age of 5 prior to the second peak of upper lip development (Zhu *et al.*, 2008). It is therefore expedient that reference perioral anthropometric dimensions be established for Igbo preschoolers as Surgeon's skills and precision could be evaluated by postoperative orofacial parameters.

CONCLUSION

Data generated from this study provides useful clinical references for the repair of cleft lip, presurgical planning of labiaplasty and lip enhancement surgeries.

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Conflicts of interest: There are no conflicts of interest.

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