OPEN ACCESS
Scholars International Journal of Anatomy and Physiology
Abbreviated Key Title: Sch Int J Anat Physiol
ISSN 2616-8618 (Print) |ISSN 2617-345X (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Orbitofacial Photometric Analysis in Nigerian Children

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DOI: 10.36348/sijap.2023.v06i02.002 | **Received:** 09.12.2022 | **Accepted:** 21.01.2023 | **Published:** 14.02.2023

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Abstract

Aim: This study was conducted to gather data on the normal measurements of facial features in healthy children from South-East Nigeria. The aim was to measure the distance between the pupils (IPD), the distance between the inner corners of the eyes (ICD), and the distance between the outer corners of the eyes (OCD) in order to establish a reference for ophthalmological assessments and diagnoses. The study was based on the understanding that these orbitofacial measurements and canthal indices are important tools for anatomists and craniofacial surgeons in evaluating systemic syndromes, craniofacial abnormalities, and post-traumatic telecanthus. ***Method:*** A sample of 120 healthy subjects within the age range of 1 to 5 years was enrolled in this study. The photographs of the face were captured non- invasively using a Nikon D 90 camera, orbitofacial landmarks were identified and measured using Image J Software. The data was then analyzed to determine the normal measurements for these facial features in healthy children from South- East Nigeria. ***Results:*** showed that all parameters measured (IPD, ICD, OCD) were higher in females than in males, but the difference was not statistically significant. ***Conclusion:*** The study presents a primary data base for orbitofacial anthropometric indices of children in South-East Nigerian which can be used as a reference for ophthalmological assessments and diagnoses. This data can be used to aid in the diagnosis of craniofacial abnormalities and post-traumatic telecanthus, as well as to evaluate systemic syndromes. Additionally, this study can be used as a benchmark for future studies on this topic in the same population or other population as well.
Keywords: Canthal indices, Children, Ophthalmology, Orbitofacial.

INTRODUCTION

Orbitofacial measurements and canthal indices serves as an important tool to anatomists and craniofacial surgeons (Lakshminarayana *et al.*,1991; Evereklioglu *et al.*, 2001) in evaluating systemic syndromes, craniofacial abnormalities, surgical treatment of posttraumatic telecanthus (Farkas *et al.*, 1992).The clinical observation of the face especially the orbital region remains an essential part for the clinical evaluation of phenotypic anomalies which can take on many forms from subtle variations in the shape and size of the eyes to more dramatic differences in the symmetry of the facial features. Through careful examination of the face, especially the orbital region, medical professionals can gain valuable insights into genetic and developmental disorders, helping to identify potential conditions and guiding further diagnostic testing or genetic referrals.

Clinical evaluation of interocular distances typically involves measuring the distance between the pupils (interpupillary distance), as well as the distances between the inner and outer corners of the eyes (Inner and outer canthal distances) and comparing them to established normal values (Farkas *et al.*, 1992). However, these normal standards may not always be available or, when published data are available, they include mostly the Western populations (Barone *et al.*, 2002).

Dysmorphologist employs canthal measurements in evaluating the degree of hypertelorism while dentist employs inner canthal distances as a reliable predicator of maxillary canal incisor width when it is multiplied by a decreasing function value of the geometric progression term and then divided by two(Abdullah, 2002).Standard values of inner intercanthal, outer-intercanthal, and inter- pupillary distances have been described to be very useful in the diagnosis of neural crest migration anomalies such as Waardenburg syndrome (Kitaoka *et al.*, 2001).

Population norms of both pupil size and PD are also useful to the optical industry for the design of intraocular lenses and play an important role in the degree of monochromatic aberrations of the eye after corneal surgery (Applegate and Howland, 1997). Interpupillary distance is correlated with head size (temple width) and together these values can aid the optical industry in designing and manufacturing lenses (Quant and Woo, 1992).

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 the 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 consent was obtained from guardians /parents of selected subjects per the ethical guidelines of the Helsinki declaration of 1975 as revised in 2013.

Inclusion Criteria

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

METHODS

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 (4.5 cm) for ease of conversion to real-life measurements (Ozioko *et al.*, 2020).

Images were acquired using Nikon D9O digital single-lens reflex camera. Camera settings were adjusted to 12.3 megapixels, 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 was positioned on a line marked 100cm from the camera (Ozioko *et al.*, 2020**)** and photos were taken parallel to the subject's 100 cm mark to reduce image perspective distortion.

METHODOLOGY OF MEASUREMENT

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

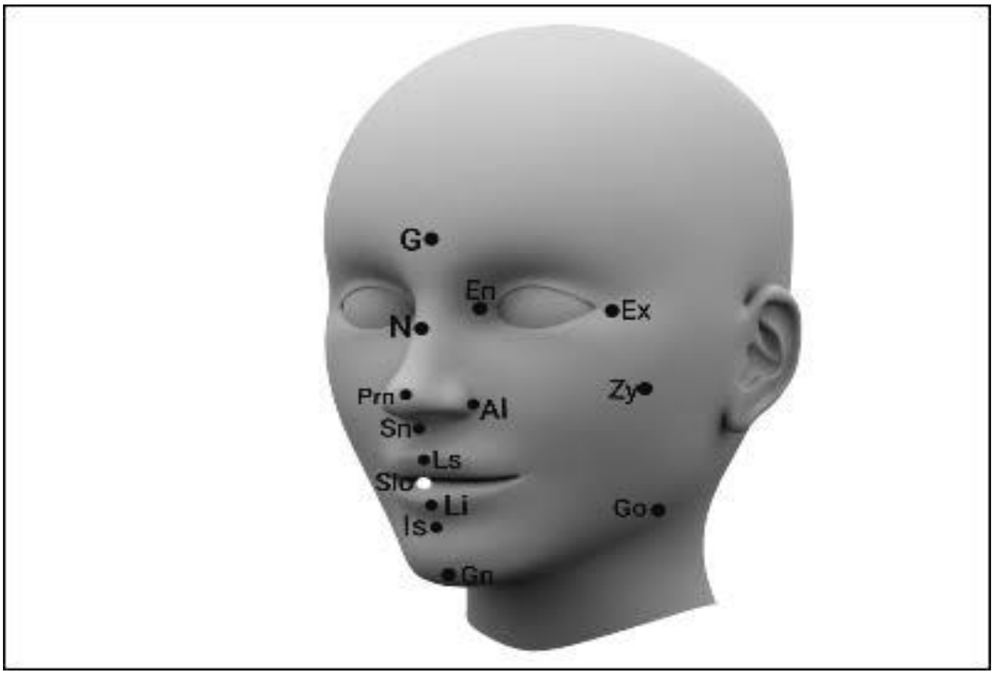

Fig. I: Facial landmarks

S/N	PARAMETERS	Anthropometric landmark
1	Face Width(zy-zy)	Zygion-Zygion (Chia and Anyanwu 2021)
2	Face lenght (n-gn)	Nasion –Gnathion (Satija *et al.*, 2010)
3	Lower face width (go-go)	Gonion-Gonion (Seo *et al.*, 2016)
4	Lower face height (sn-gn)	Subnasale-gnathion)(Akinlolu 2016)
5	Inner canthal distance (en-en)	The distance between the medial canthus of both eye (Chia and Anyanwu 2021).
6	Outer canthal distance (ex-ex)	Exocathion- Exocathion (Egwu *et al.*, 2008)
7	Palpebral fissure width(ex-en)	Exocathion- Endocathion (Stromland *et al.*,1999)
8	Interpupillary distance(IPD)	The distance between the two mid pupillary region in the front gaze (Osuobeni and Al-ghani1994)
9	Facial index	100*gn-n/zy-zy (Ogodescu *et al.*, 2021)
10	Intercanthal index	100*en-en/ex-ex (Osunwoke *et al.*, 2012)

Gender differences were explored using Student's t-test with the alpha level set at 0.05. All statistical analyses were performed with the aid of the statistical package for the Social Sciences version 23 presented as mean ± standard and P-value < 0.05 was considered statistically significant.

RESULTS

Descriptive Statistics of Orbitofacial Parameters in Relation to Sex (1-5yrs)

Parameters(cm)	Male	Female	P-value
Face width	8.59±0.95	8.84±0.67	0.262
Face length	7.59±0.67	7.87±0.81	0.071
Lower face width	6.35±0.93	6.63±0.93	0.968
Lower face height	4.61±0.58	4.77±0.59	0.906
Inner Intercanthal distance	2.63±0.29	2.75±0.31	0.402
Outer Intercanthal distance	7.48±0.56	7.61±0.56	0.973
Palpebral fissure width	2.42±0.26	2.44±0.25	0.924
Interpupillary distance	5.16±0.45	5.21±0.40	0.420
Intercanthal index	35.15±2.97	36.09±2.67	0.792
Facial index	89.02±7.09	89.03±6.67	0.557

Table Shows results from the data separated into male and female subgroups to analyze changes in orbitofacial parameters in relation to sex. Females were observed to have higher mean orbitofacial parameters than males though not statistically significant.

DISCUSSION

The orbitofacial region of the face is considered aesthetically important because even small differences (congenital or acquired) in this area can cause imbalances and asymmetry. In facial surgery, perioperative planning and surgical precision are largely dependent on facial indices which predict the functional outcome postoperatively. Maxillofacial surgeons have emphasized the relevance of facial proportions among different racial inclinations (Dennis *et al.*, 2015).

Results from the present study showed no significant difference in facial measurements between genders in children under the age of 5, suggesting that sexual dimorphism may not be as prominent in young children as often reported in adults and older children.

The current study reveals a lower upper face width measurement for both boys and girls, with boys measuring at 85.9±0.95mm and girls at 8.84±0.67mm. This is in contrast to the findings of Ukoha *et al.*, (2012), who reported a wider upper face width of 99.7mm for boys and 99.1mm for Nigerian girls aged 1 to 6 years. Additionally, Obikili *et al.*, (2022) also found no significant differences in facial width between genders among older children and teenagers aged 5 to 19 years, indicating that these measurements may not change significantly with age. However racial inclinations revealed marked differences in facial width parameters as observed from the studies of Milicescu *et al.*, 2001, who reported a value of 125.5 mm- 129.6 mm for boys (7–11 years age interval), and 122.9 mm - 126.3 mm for Romanian girls, Arboledo *et al.*, 2011 similarly reported 120–136 mm for Colombian mestizos boys, 118–131 mm for mestizos girls.

The mean gonial width/lower face width obtained from this study (6.35±0.93mm for males and 6.63±0.93 mm for females), and facial height (75.9mm in males and 78.7mm in females) were closer to the values reported by Bobcoc *et al.*, (2009) and Ukoha *et al.*, (2012) who reported mean values of 80–87 mm for boys and 78–85 mm for girls and 75.7mm in males and 76.7mm in females respectively. In contrast, other studies by Ogodescu *et al.*, (2021),Arboledo *et al.*, (2011),Milisecu *et al.*, (2001),Krishan *et al.*, and Seo(2016) *et al.*, revealed much higher values of mean gonial width ranging from 92mm to 108mm and facial height of 86mm to 118mm in different populations.

The determined Face height (N-Gn) in our sample is lower than that reported by Krishan *et al.*, (2007) Ogodescu *et al.*, (2021) and Seo *et al.*, (2016). This may suggest that the orbitofacial growth of Nigerian children below the age of five is unaffected by gender-discriminating factors such as social-cultural inequalities or nutritional deprivation often associated with most populations. It is also reasonable to deduce that environmental influence on early infancy exposure may not be different in boys and girls leading to equal face length and breadth.

Compared to the present study, the overall face length (5.17cm) and breadth (6.42 cm) of Patiala infants reported by Satija *et al.*, 2010 were lower than those obtained in this study. Differences observed in facial measurements may be attributable to influences of genetic, cultural, nutritional, environmental, and racial factors. This implies that local values derived from well-defined populations should be used as references in the evaluation of cases with dimorphic features.

The current study found no significant differences in facial measurements between males and females. This is in agreement with previous research on Chinese babies, which also found no statistical differences in facial length and breadth between genders (Fok *et al.*, 2003; Wu *et al.*, 2000). Furthermore, our data on inner intercanthal distance (IICD) also aligns with earlier studies on children under 5 years old, with mean IICD measurements of 26.3±0.29 mm for males and 27.5±0.31 mm for females (Osunwoke *et al.*, 2012; Kaimbo and Kayembe, 1994). However, other studies in different populations with older age groups have found an increase in the mean IICD value (Evereklioglu *et al.*, 2001; Quant and Woo, 1992; Vasanthakumar *et al.*, 2013).

This study found that the mean values for outer intercanthal distance (OICD) were in agreement with previous research on children aged 3-7 years old, with mean OICD measurements of 83.73±4.75 mm for males and 84.05±5.28 mm for females (Osunwoke *et al.*, 2012). However, studies on older age groups have reported higher OICD values, with Vasanthakumar *et al.*, (2013) reporting 95.55±6.39 mm for males and 92.44±4.71 mm for females, Agarwal *et al.*, (2013) reporting 92.23±1.87 mm for males and 95.69±1.62 mm for females, and Evereklioglu *et al.*, (2001) reporting 85.73±4.28 mm for males and 84.61±3.86 mm for females

A Turkish study by Meltam *et al.*, (2014) found that the mean inner intercanthal distance (IICD) in males was 28.68 ± 3.61 mm and 27.84 ± 2.90 mm in females, while the mean outer intercanthal distance (OICD) was 96.43 ± 11.90 mm for males and 95.08 ± 9.85 mm for females. These values are higher than the ones found in the present study. A study on the Saudi population by Amal *et al.*, (2011) found no significant difference in the mean values of IICD and OICD with respect to age and gender, which is in line with the findings of the present study. In contrast, a study on the Iranian population by Mohammad *et al.*, (2008) found higher mean IICD and OICD values of 29.16 ±3.31mm and 78.86±7.7mm for males, and 29.2±3.4mm and 80.45±9.22mm for females, which are higher than the values reported in the present study.

The Intercanthal indices reported in our study are in concordance with the study of Osunwoke *et al.*, (2012) & Evereklioglu *et al.*, (2001)who reported a canthal index of 30.02±1.93m for males and 29.31±1.88m for females and 34.72 ± 2.25 for males and 35.04 ± 2.35 for females in Nigerian and Turkish population respectively. In the present study, the interpupillary distance reported was observed to be similar to the values obtained by Osuobeni and Al-Musa, 1994 in Arabian children aged 5-15 years (55.68±2.52mm), Osunwoke *et al.*, (2012) however reported interpupillary distance of 51.65±3.19mm in males and 50.52±3.28mm in females aged 3-7 years while Evereklioglu *et al.*, (2002) (2001) in his Turkish study reported an IPD of 50.52±3.28 for males and 55.31 ± 3.29 for females. Contrarily, Quant and Woo (1992) in their Hong Kong Chinese study of children aged 7 years reported a mean IPD of 33.30mm for males while for females 34.00mm respectively.

The intercanthal indices reported in the present study are consistent with previous studies on Nigerian and Turkish populations. Osunwoke *et al.*, (2012) and Evereklioglu *et al.*, (2001) reported canthal index measurements of 30.02 ± 1.93 for males and 29.31 ± 1.88 for females, and 34.72 ± 2.25 for males and 35.04 ± 2.35 for females, respectively. The interpupillary distance measurements in the present study are also similar to values found by Osuobeni and Al-Musa (1994) in Arabian children aged 5-15 years (55.68 ± 2.52 mm). However, Osunwoke *et al.*, (2012) found a lower interpupillary distance of 51.65 ± 3.19 mm for males and 50.52 ± 3.28 mm for females aged 3-7 years, while Evereklioglu *et al.*, (2001) in his Turkish study reported an IPD of 50.52 ± 3.28 mm for males and 55.31 ± 3.29 mm for females. In contrast, Quant and Woo (1992) in their study of Hong Kong Chinese children aged 7 years reported a mean IPD of 33.30 mm for males and 34.00 mm for females.

In the present study, no significant difference was observed in Palpebral fissure width values with respect to gender in all the age groups which are consistent with previous research (Osuobeni *et al.*, 1994). These measurements were also found to be higher than previous studies (Strömland *et al.*, 1999).

These obtained values can be useful for identifying certain medical conditions, designing glasses and in forensic studies.

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