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Anthropometric Analysis of Cephalic Index in Orlu Population of Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: The cephalic index is an anthropometric parameter indicating head shape and cranial proportions. This study aims to evaluate the cephalic index of the Orlu population of Imo State, Nigeria.
Methods: the study adopted a descriptive cross-sectional study design where 200 subjects, (100 females and 100 males) between the ages of 18-37 years were recruited for the study. Standardized anthropometric techniques were used to measure the head breadth and head length. Data analysis was done using a statistical package for social sciences version 23. T-test and Chi-

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square were used to evaluate the head type. A probability less than 0.05 ($p<0.05$) was considered statistically significant and 95% was denoted as confidence level.
Results: The study shows the average mean cephalic index of all subjects (77.68±9.85), while that of males and females was 79.08±7.16 and 76.2811.82, 76.28±11.82 respectively. The dominant type of head shape was the hyperbrachycephalic phenotype in males (61.9%), while the dolichocephalic phenotype in females (58.3%).
Conclusion: The study evaluates the sexual dimorphism of the cephalic index, which shows that males have higher anthropometric values than females. This will be useful in forensic medicine and anthropological applications.

Keywords: Head breadth; head length; orlu; cephalic index.

1. INTRODUCTION

Anthropometric analysis plays a role in understanding human biological variation, providing insights into genetic, environmental, and evolutionary factors that shape physical characteristics across populations Oghenemavwe et al., [1]. The cephalic index is an anthropometric parameter indicating head shape and cranial proportions. It has emerged as a significant measure in clinical anthropology Grabcika et al., [2]. The cephalic index, calculated as the ratio of head width to head length, categorizes head shape into types such as dolichocephalic (long-headed), mesocephalic (medium-headed), brachycephalic (short-headed) and hyperbrachycephalic (broad or round). Variations in cephalic index within populations can reflect genetic, environmental, and evolutionary factors that influence cranial morphology [3].

In Nigeria, previous research done on the cephalic index, it was observed that Dolichocephalic was predominant in Igbo [4] and Ogbia [5]. Brachycephalic in Ijaw [6] and Mesocephalic in Ijaw females and Igbo (males and females) [6]. However, several studies on the cephalic index have been done in other countries in West Bengal [7], North India [8] and India [9].

Orlu, a region predominantly inhabited by the Igbo ethnic group, presents a unique opportunity for anthropometric research due to its relatively distinct ethnic and cultural heritage. Assessing the cephalic index within Orlu allows for better contextualization of cranial development and potential clinical implications related to head shape, exploring how factors such as genetics, diet, and lifestyle impact cranial morphology. Moreover, no study on the cephalic indices of the Orlu population has been carried out. Thus, this study aimed at documenting the cephalic index of the Orlu population which could be important in anthropological studies, forensic medicine, and clinical practice and contribute to a holistic understanding of human cranial diversity.

2. MATERIALS AND METHODS

2.1 Study Design

The cephalic index of the Orlu population in the Imo State of Nigeria, including head breadth and length, was measured using a cross-sectional descriptive research approach. For the three-month study period (August to October 2024), two hundred subjects between 18 and 37 years made up the study population (100 males and 100 females) for the study. The study uses IMSUT (Imo State University Teaching Hospital) as the study area. the subjects were selected impartially using a multi-stage random proportionate sampling approach.

2.2 Selection Criteria

2.2.1 Inclusion criteria

Only participants whose parents and grandparents are from Orlu in Imo State Nigeria and have no deformity in their head morphology were selected for the study.

2.2.2 Exclusion criteria

Subjects who are not of Orlu origin and have had surgery that might have affected the head morphology were excluded from this study. subjects outside the study age bracket were excluded.

2.2.3 Anthropometric landmarks

The following measurements (cm) were taken when the subjects were sitting in a relaxed position and their head in a Frankfurt plane or natural head position (NHP)

2.2.3.1 Head length (HL)

Measures the straight distance between the glabella (the most prominent point on the frontal bone above the root of the nose, between the eyebrows) and the opisthocranion (the prominent portion of the occiput, close to the midline on the posterior rim of the foramen magnum).

2.2.3.2 Head breath (HB)

Measures the distance between the most lateral points of the parietal bone. It is also called the maximum bi-parietal diameter. The CI (Cephalic Index) was then calculated as MHB/ MHL x 100

2.3 Methods of Data Collection

The semi-constructive descriptive questionnaire and a personal interview were used to gather the sociodemographic data (age and sex) for the Orlu population. This ensured that the subjects met the inclusion criteria and were fit to participate in the study. The head breadth and head length were measured using a spreading calliper, adopting the appropriate anatomical landmarks. Data readings were recorded and preserved by the authors.

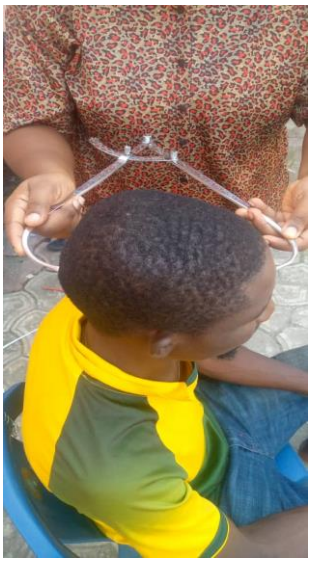

Fig. 1. The measurement of head length (*source: field survey*)

2.4 Methods of Data Analysis

Data obtained were subjected to statistical analysis using the International Business Machine of Statistical Package for Social Science (IBM version 23). The results obtained were presented in the Table as mean ± standard deviation. T-test was used as an inferential statistic to evaluate sexual and asymmetry differences

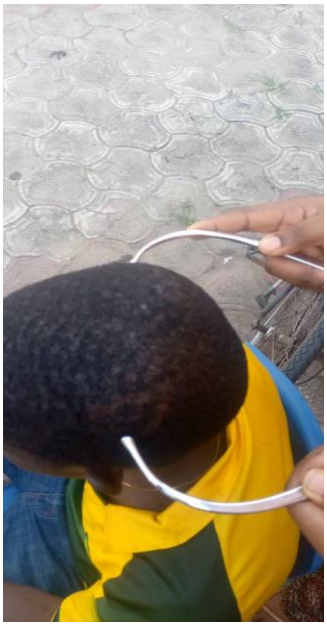

Fig. 2. The measurement of head breadth (*source: field survey*)

3. RESULTS

The present study comprised two hundred subjects of Orlu indigen who were 18-25 years of age. Table 1 shows the descriptive comparison between the subjects showing that all subjects had an average mean head length of 18.92±2.13, head breadth of 15.51±12.85 and for all subjects were cephalic index of 77.68±9.85. The inference has shown that there were sexual differences in the cephalic index where the average mean of males was 79.08±7.168 while the females were 76.28±11.82 (Table 2). Head type of the Orlu Population shows that the males are 41.7% Dolichocephalic, 46.1% Mesocephalic 58.2% Brachycephalic and 61.9% Hyperbrachycephalic while the females are 58.3% Dolichocephalic,53.9% of Mesocephalic, 41.8% of Brachycephalic and 38.1% of Hperbrachycephalic (Table 3). Table 4 shows the Comparison of studies on the cephalic index among various population groups.

List 1. Classification of head types according to Martin and Saller (1957)

Head type	Range of Cephalic Index (CI%)
Dolichocephalic	< 74.9
Mesochepalic	75-79.9
Brachycephalic	80.84.9
Hyperbrachycephalic	>85

Table 1. Descriptive statistics of head length and head breadth in orlu population

Parameter	N	Minimum	Maximum	Mean	Std. Deviation
Head length	200	14.70	43.50	18.9265	2.13074
Head breadth	200	6.80	195.20	15.5107	12.85501
Cephalic Index	200	31.03	100.68	77.6878	9.85285

Table 2. Sexual differences of cephalic index in orlu population

	sex	N	Mean	Std. Deviation	Std. Error Mean	t	p-value	Inference
cephalic index	male	100	79.0865	7.16867	.71687	2.023	0.04	S
	female	100	76.2891	11.82352	1.18235			

S= Significant

Table 3. Head type of orlu population

	Head Type						
Sex	**Dolichocephalic**	**Mesocephalic**	**Brachycephalic**	**Hyper brachycephalic**	**Chi-square**	**p-value**	**Inference**
Male	41.7%	46.1%	58.2%	61.9%	4.470	0.21	NS
Female	58.3%	53.9%	41.8%	38.1%			
Total	**24.0%**	**38.0%**	**27.5%**	**10.5%**			

NS= Not Significant

Table 4. Comparison of studies on cephalic index among various population groups

		Cephalic Index	
Authors/ Year	**Region**	**Male**	**Female**
Oladipo and Olotu, 2006	Ijaw	80.98	78.24
Oladipo and Olotu, 2006	Igbo	79.04	76.83
Oladipo and Paul, 2009	Urhobo and Itsekiri	82.16	86.80
Oladipo et al., 2009	Ogoni	111.18	75.09
Anupam et al., 2009	Punjab	81.34	85.75
Eroje et al., 2010	Ogbia, Nigeria	73.68	72.24
Odokuma 2010	West Africa	77.67	78.1
Ilayperuma, 2011	Srilanka	78.04	79.32
Anitha 2011	North Indian	79.14	80.74
Salve and Chandrashekhar, 2011	Andhra Pradesh	75.68	78.2
Gujaria and Salve, 2012	Marathi	77.08	79.02
Yagain et al., 2012	India	77.92	80.85
Kumar and Gopichand, 2012	Haryanvi	66.72	72.25
Jeremiah et al., 2013	Kenya	71.04	72.3
Kumar and Nagar, 2015	North Indian	73.75	75.22
Shah et al., 2015	Gujarat	77.20	75.19
Ekezie et al., 2016	Igbo	68.8	73.6
Setiya et al., 2018	Mahakaushal	77.65	78.13
Present study	Orlu	79.08	76.28

4. DISCUSSION

The present study assesses the anthropometric analysis of cephalic index variation in the Orlu Population. The findings of this study found that the cephalic index of an average value of males was higher than that of females ($p > 0.04$). The study findings are consistent with the biological and developmental distinctions between genders especially in the skull growth patterns which genetic, hormonal, and developmental factors could influence [10]. Males typically have a greater cephalic index due to their more robust cranial growth, particularly in areas that contribute to skull width [11]. Bone density and structure can be affected by hormones, especially testosterone, which can slightly change the size of the skull in both sexes [12]. Furthermore, as environmental and evolutionary influences can affect cranial shape differently for males and females throughout time, genetic diversity both within and between populations may contribute to these variances [13]. The sexual variance shown in this study agreed with other research across many populations, which found that males and females differ significantly ($p < 0.04$) from one another Oladipo and Olotu, [6], Abolhasanzadeh and Farahani, [14], Eroje et al., [5] and Fawehinmi et al., [15]. But it also agrees with sexual dimorphism as reported by Ekezie et al., [4] whose cephalic index of males (68.80±12.33) was a bit lower than that of the females (73.60±16.15).

In our study, males' dominant type of head shape was hyper brachycephalic phenotype (61.9%) but the mean cephalic index was 79.08 (mesocephalic). This finding of hyper brachycephalic was similar to other studies by Golalipour et al., [16] and Vojdani et al., [17] but not similar to the studies of Yagain et al., [18], del Sol, [19] and Abolhasanzadeh and Farahani, [14]. The other dominant type of head shape in females was the dolichocephalic phenotype (58.3%) but the mean cephalic index was 76.28 (mesocephalic). This finding of dolichocephalic was similar to other studies by Ekezie et al.,[6], Eroje et al., [5], Shah, and [20], but not in line with the study of Mangeshkar et al., [21]. The kind of diet taken among the Orlu people could also play a role in influencing the dominant head shape such as akpu (cassava), okpa, yam, abacha (Africa salada) and cocoyam. It was observed that the head shapes can also change from one generation to the other, in a case study of Heravi and Zieaee,[22] where the first generation of Japanese immigrants in Hawaii, was noticed that they had an increased head breadth, a decreased head length and a higher cephalic index than their parents which is attributed to the factor that hereditary and environmental factors such as nutrition and cultural practices might also play a role in skull morphology. This study shows the importance of anthropometric research on cranial indices within this population can enhance our understanding of biological diversity and provide baseline data

for medical, forensic, and anthropological applications.

5. CONCLUSION

In conclusion, this study shows a significant increase of hyperbrachycephalic and brachycephalic in males while in females shows a significant increase of dolichocephalic and mesocephalic and both significant decrease of dolichocephalic, mesocephalic, brachycephalic and hyperbrachycephalic head shape in both sexes.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT

A written consent was distributed to all the subjects explaining the nature of the research and only those who consented were allowed to participate in the study. The consents were retrieved and preserved by the authors.

ETHICAL APPROVAL

Ethical approval was obtained from the Research Ethics Committee, of the University of Port Harcourt, Port Harcourt, Nigeria (UPHCEREMAD/REC/MM/91/046). All subjects were adequately informed about the procedure of studies and they gave their consent in writing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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