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Morphometry and Morphology of the External Ear of Omumu Indigenes in Rivers State, Nigeria

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Abstract

Background: This study investigates the morphometric and morphological characteristics of the external ear in the Omuma population, a distinct ethnic group in Nigeria. The external ear's unique anatomy and its individual variability, influenced by genetic, environmental, and cultural factors, have applications in forensic science, anthropological research, and clinical medicine. The research aims to provide baseline data specific to this population, filling a gap in the existing anthropometric literature. ***Materials and Method:*** A descriptive cross-sectional study design was employed in Omuma, Rivers State, Nigeria. Participants 250 volunteers aged 16–45 years, with both parents and grandparents from the Omuma ethnic group. Sampling Method: Random sampling, with sample size determined using the Taro Yamane formula. Materials and Techniques: smart camera, 2 cm graph paper, Vernier calipers, and statistical software for analysis. Morphometric data included parameters such as ear length, width, and lobule dimensions. Morphological observations documented variations in ear shape and structure. ***Results and Discussions****:* The findings reveal significant morphometric and morphological variations in the external ear among the Omuma population. Sexual Dimorphism: Male participants exhibited larger ear dimensions compared to females. Variations aligned with genetic and environmental influences unique to the Omuma group. The study corroborates earlier findings on the relevance of ear dimensions in forensic identification, reconstructive surgery, and anthropological research. The significance levels observed for ear length, width, and lobule height ($p < 0.05$) validate the importance of these parameters in distinguishing sex and ethnicity. Conversely, the non-significance of lobule width ($p > 0.05$) indicates that this measure may not be a reliable indicator of sexual dimorphism in this population. ***Conclusion****:* This research provides essential baseline data for the Omuma population, highlighting the clinical, forensic, and anthropological importance of understanding population-specific ear morphology. The results of this study revealed that free earlobes occurred more frequently than attached earlobes and earlobe attachment did not demonstrate any significant correlations with either gender or age group. Also, males had slightly higher lobule lengths and widths than females, but these differences were not statistically significant.

Keywords: Morphometry and Morphology, Omuma Indigines, Rivers State, Ear Length, Width and Shape.

1. INTRODUCTION

The external ear (auricle) plays a significant role in anthropological and forensic science due to its unique morphometric and morphological traits. Studies

like those of [1] underline its individual variability and adaptability to genetics, environment, and cultural practices.

Variability in Ear Morphology

Variations in ear morphology reflect influences such as age, sex, genetics, and cultural practices [2]. Features like ear length, lobule shape, and concha depth offer critical data for forensic identification, reconstructive surgery, and anthropological studies [4]. These characteristics remain relatively stable through adulthood, making them reliable for biometric analysis.

Research Problem

The Omuma population has unique anthropological and cultural significance, yet its external ear morphology has not been extensively studied. This gap limits its utility in specific clinical, forensic, and anthropological contexts.

Morphometry and Morphology of the External Ear

Morphometry involves the quantitative measurement of anatomical structures, focusing on parameters such as auricular length, width, and lobule dimensions. Morphological studies examine qualitative traits like shape and texture, offering a comprehensive view of variability.

Influences on Morphological Variability

- **Genetics:** Ear morphology is highly heritable, with distinct markers passed through generations [5].
- **Environmental Factors:** Conditions like climate and cultural practices (e.g., ear adornments) impact ear structure and functions [6].
- **Age and Sex:** Male ears are generally larger, and age-related changes include lobule elongation and auricular widening [7].

Forensic and Clinical Applications

- **Forensic Science:** Unique ear features assist in personal identification [8].
- **Clinical Relevance:** Morphometric data guide reconstructive surgeries and hearing aid designs, ensuring functional and aesthetic success [9].
- **Anthropological Significance:** Comparing ear morphology across populations reveals migration patterns and evolutionary adaptations [10].

Morphometric Standards

Existing studies highlight significant inter-population differences in morphometric parameters:

- Studies done on an Indian population showed that all parameters were higher in males except left lobular width, which was higher in females. The mean observation of the right and left ear length of males were 4.61± 0.41 cm, 4.54± 0.44 cm respectively, while in females were 3.68± 0.42 cm, 3.67±0.54 cm respectively. [2].
- In Nigerian populations, males generally exhibit larger ear dimensions than females [3].

2. MATERIALS AND METHODS

2.1: Research Design

The design for this sturdy was a descriptive and cross-sectional sturdy. Which employed two method a morphometric and morphological sturdy that involved descriptive and measurement procedure. This sturdy was done specifically to generate a data for the morphometric and morphological variations peculiar among the Omuma population.

2.2: Study Area

Omuma is a Local Government Area located in Rivers State, within the South-South geopolitical zone of Nigeria. The headquarters of Omuma LGA are situated in the town of Eberi, and the area is primarily inhabited by Igbo people. Established in 1989, Omuma spans 170 square kilometers and recorded a population of 100,366 in the 2006 census. The postal code for Omuma is 512 also the LGA comprises several towns and villages, including Umuabali, Umuroke, Eberi, Egbelu, Umuokwa, Umuoroyo, and Umudik. Omuma is known for cultural events such as the Ogwu Ekpeye festival. Christianity is the dominant religion in the area. Omuma's climate is characterized by an average humidity level of 78 percent, with the presence of rivers and tributaries enhancing its natural landscape. The LGA boasts a lively trade sector, featuring markets like Eketa market, where a wide range of goods is available. Additionally, Omuma serves as an agricultural center, cultivating crops like yam, maize, palm oil, and vegetables. The people are also engaged in fishing, crafts, lumbering, and hunting, which contribute to the local economy National Population Commission. (2006).

2.3: Research Population

A total of 210 volunteers between the age of 16 to 45 whose parents and grandparents are indigene of the Omuma LGA was recruited for this study.

2.4: Eligibility Criteria

Subjects are selected according to their availability and willingness to participate without payment or any other kind of reward, based on their origin and racial strain criteria, to ensure that the samples are true representatives of their respective target populations. Only consenting participants within the age bracket of 16–45 years were allowed to participate in this study.

Inclusion criteria

The sample subject must be within the speculated age range of 16–45 years and must be a indigines of omumu by both parents and grandparents, with no history of ear anomaly or previous ear surgery.

Exclusion criteria

Non-indigenes and Indigens with ear deformity and students whose ages don't fall within the age bracket.

2.5: Sample Size

The sample used was simple random sampling method, the minimum sample size was calculated using Taro Yamane Formula

$n = N (1+N (e^2))$

Given:
n = sample size
N =100,366 (estimated population)
e = 0.05 (a common margin of error for a 95% confidence level)

Substitute the values:
n = 398.42 participants.

2.6: Sampling Technique

Simple random sampling technique was used for this study in order to ensure Every individual from the population has an equal chance of being chosen, then individuals will be chosen based on the criteria

2.7: Method of Data Collection and Instrumentation

Primary Data collection was applied to obtain the parameters of Lobule in process of obtaining this data. A consent form was administered to them to provide information on what the research details, even possible risk factors and future benefits

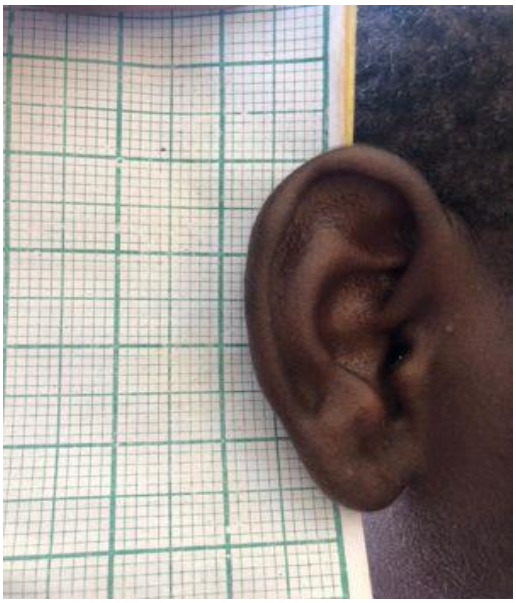

Figure 2.1: Image showing measurements of ear Lobular length using Graph

Figure 2.2: Image showing measurements of ear Lobular width using Graph

Figure 2.3: Image showing the morphology of ear the Lobule (Free and attached)

- **Lobule Length:** The Lobule Length was considered from the midpoint of the intragastric notch to the lowest point of the Lobule
- **Lobule Width:** The Lobule width as horizontal width of the Lobule from the 2 ends
- Morphology: It was done in broad daylight, using my sight and my hand to confirm if it was free or attached
- **Ear Lobule Length:** The ear lobule length was measured as the vertical distance from the point where the lobule attaches to the face (base) to the lowest tip of the lobule. This measurement provides insights into age-related changes, sexual dimorphism, and population-specific traits.
- **Ear Lobule Width:** The ear lobule width was defined as the maximum horizontal distance across the lobule. Measurements were taken at the widest point using Vernier calipers. Lobule width is a critical parameter for assessing proportionality and variations among individuals.
- **Shape of the Ear Lobule:** The ear lobule's shape was visually categorized into two main types:
- **Free-Hanging Lobule:** A distinct and detached lobule with a visible gap between the lobule and the face.
- **Attached Lobule:** The lobule is directly connected to the side of the face without any separation.

2.8: Method of Data Analysis

The data obtained was analyzed using Statistical Product and Services (SPSS) VERSION 28 through a quantitative means p value ≤ 0.05 was considered statistically significant. The independent t-test and Chi-square were also used to test for association between variables.

2.9: Ethical Consideration

Ethical research approval was obtained from the research committee in our faculty of basic medical science, then the consent form was obtained for the respondents and the confidentiality information of the respondents was ensured that it will be kept safe, if they want to opt out, they are free.

3. RESULTS

The results from the data analyzed were presented in tables and graphs were necessary.

Table 1: Sociodemographic characteristics

Sociodemographic characteristics	Frequency	Percentage
Gender		
Male	94	44.8
Female	116	55.2
Total	210	100.0
Age bracket		
16 -19years	87	41.4
20-23years	50	23.8
24 – 27years	44	21.0
28 – 31years	29	13.8
Total	210	100.0

The results showed that the females (55.2%) were more prevalent than the males, and the most frequent age category was 16 – 19years with proportion of 41.4%.

Table 2: Pattern of earlobe attachment among participants

Variable(s)	Frequency (n)	Percentage (%)
Earlobe attachment		
Free	122	58.1
Attached	88	41.9

Free earlobe 122(58.1%), attached earlobe 88(41.9%). The free earlobes were most frequent.

Table 3a: Descriptive statistics of lobule length and width of participants

Variables	Mean (mm)	Standard Deviation (mm)	Standard Error (S.E) (mm)
Left lobule length	20.534	13.468	0.929
Right lobule length	20.854	12.757	0.880
Left lobule width	15.645	4.747	0.327
Right lobule width	16.052	6.355	0.438

The mean value of the left and right lobule length (Mean) were 20.5340.929mm and right 20.8540.880mm respectively. Similarly, the left and right lobule width (Mean±S.E) were 15.6450.327mm and 16.0520.438mm.

Table 3b: Descriptive statistics for Independent t-test of the association between left lobule length

Variable	N	Mean (mm)	Std. Deviation (mm)	Std. Mean Error (S.E) (mm)
Gender				
Male	94	21.648	19.394	2.000
Female	116	19.631	4.863	0.451

The mean lobule length of the male participants (Mean was 21.648 The females had an average lobule length of 19.6310.451mm. The males had a higher lobule length than the females.

Table 3c: Independent t-test of the association between the left lobule length and gender of the participants

Variable	F	Sig	T	Df	p-value	Mean diff	95% Confidence interval	
							Lower	Upper
Left lobule length								
Equal variances assumed	1.794	0.182	1.080	208	0.282	2.017	-1.666	5.700
Equal variances not assumed			0.984	102.5	0.328	2.017	-2.050	6.084

The mean lobule length of the male (n=94) participants (Mean was 21.6482.000mm. The females (n=116) had an average lobule length of 19.6310.451mm. Levene's test (p=0.182) indicated that variances between the groups were statistically equal. At equal variances assumed, independent samples **t-test** (p=0.282) indicated that the mean left lobule length of males and females were statistically equal.

Table 4a: Descriptive statistics for Independent t-test of the association between right lobule length

Variable	N	Mean (mm)	Std. Deviation (mm)	Std. Mean Error (S.E) (mm)
Gender				
Male	94	20.779	6.921	0.713
Female	116	20.915	16.033	1.488

The mean right lobule length of the male participants (Mean was 20.779 The females had an average lobule length of 20.9151.488mm. The females had a higher lobule length than the males.

Table 4b: Independent t-test of the association between the right lobule length and gender of the participants

Variable	F	Sig	T	Df	p-value	Mean diff	95% Confidence interval	
							Lower	Upper
Right lobule length								
Equal variances assumed	0.374	0.541	-0.076	208	0.939	-0.135	-3.634	3.363
Equal variances not assumed			-0.082	163.3	0.935	-0.135	-3.395	3.124

The mean lobule length of the male (n=94) participants (Mean was 20.779mm. The females (n=116) had an average lobule length of 20.9151.488mm. Levene's test (p=0.541) indicated that variances between the groups were statistically equal. At equal variances assumed, independent samples **t-test** (p=0.939) indicated that the mean right lobule length of males and females were statistically equal.

Table 5a: Descriptive statistics for Independent t-test of the association between left lobule width

Variable	N	Mean	Std. Deviation	Std. Mean Error (S.E)
Gender				
Male	94	15.930	4.980	0.513
Female	116	15.413	4.557	0.423

The mean left lobule width of the male participants (Mean was 15.930 The females had an average lobule length of 15.4130.423. The males had a higher lobule width than the females.

Table 5b: Independent t-test of the association between the left lobule width and gender of the participants

Variable	F	Sig	T	Df	p-value	Mean diff	95% Confidence interval	
							Lower	Upper
Left lobule width								
Equal variances assumed	2.150	0.144	0.784	208	0.434	0.516	-7.82	1.816
Equal variances not assumed			0.777	190.9	0.438	0.516	-7.958	1.829

The mean lobule width of the male (n=94) participants (Mean was 15.930mm. The females (n=116) had an average lobule width of 15.4130.423mm. Levene's test (p=0.144) indicated that variances between the groups were statistically equal. At equal variances assumed, independent samples **t-test** (p=0.434) indicated that the mean left lobule width of males and females were statistically equal.

Table 6a: Descriptive statistics for Independent t-test of the association between right lobule width

Variable	N	Mean	Std. Deviation	Std. Mean Error (S.E)
Gender				
Male	94	16.162	5.021	0.517
Female	116	15.962	7.280	0.675

The mean right lobule width of the male participants (Mean was 16.162 The females had an average lobule length of 15.9620.675. The males had a higher lobule width than the females.

Table 6b: Independent t-test of the association between the right lobule width and gender of the participants

Variable	F	Sig	T	Df	p-value	Mean diff	95% Confidence interval	
							Lower	Upper
Right lobule width								
Equal variances assumed	0.047	0.829	0.226	208	0.821	0.199	-1.542	1.942
Equal variances not assumed			0.235	203.1	0.815	0.199	-1.479	1.879

The mean right lobule width of the male (n=94) participants (Mean was 16.162mm. The females (n=116) had an average lobule width of 15.9620.675mm. Levene's test (p=0.829) indicated that variances between the groups were statistically equal. At equal variances assumed, independent samples **t-test** (p=0.821) indicated that the mean right lobule width of males and females were statistically equal.

Table 7: Chi square test of association between pattern of earlobe attachment and age category

Variables	**Age bracket** n (%)				X^2	**p-value**
Earlobe attachment	**16– 19years**	**20-23years**	**24-27years**	**28-31years**		
Free	52(24.8)	26(12.4)	25(11.9)	19(9.0)	1.549	0.679
Attached	35(16.7)	24(11.4)	19(9.0)	10(4.8)		
Total	87(41.4)	50(23.8)	44(21.0)	29(13.8)		

The results showed that there was significant association (p=0.679) between earlobe attachment and age category.

Table 8: Chi square test of association between pattern of earlobe attachment and gender of participants

Variables	Gender n (%)		X^2	p-value
Earlobe attachment	**Male**	**Female**		
Free	53(25.2)	69(32.9)	0.205	0.675
Attached	41(19.5)	47(22.4)		
Total	94(44.8)	116(55.2)		

The results showed that there was no significant association (p=0.675) between earlobe attachment and gender.

4. DISCUSSION

This study investigates the morphometry and morphology of the ear among the Omuma people of Rivers State, Nigeria. Using anthropometric methods, the research collected data on Lobule shape, length, and width among 250 participants, examining how these features vary by gender and age. Free earlobes were more prevalent than attached earlobes. Males had slightly higher lobule lengths and widths than females, but these differences were not statistically significant. Age was not found to affect earlobe type.

The results show that Females were more Common (55.2%) than males, and the most frequent age range was 16–19 years (41.4%). Free earlobes were more common (58.1%) compared to attached earlobes (41.9%). The mean lengths and widths of earlobes were analyzed, with males typically having slightly higher lobule lengths and widths than females, though these differences were not statistically significant.

First assessing the results revealed that free earlobe attachment is more prevalent aligns with other research indicating similar trends. This prevalence may be attributed to the genetic basis of earlobe attachment, which has been shown to follow Mendelian inheritance patterns with some degree of variability influenced by population genetics. For instance, studies conducted in various global populations have noted that free earlobes are commonly dominant compared to attached types [11,12].

This study's analysis found no significant association between earlobe type and different age groups (p-value = 0.679). This analysis indicating no significant association between age category and earlobe attachment is consistent with findings from [13], which also showed that age did not substantially impact the occurrence of free or attached earlobe types. The consistency across studies implies that earlobe attachment may be genetically determined and less influenced by external factors such as age.

Males had slightly larger lobule lengths and widths than females, but these differences were not statistically significant. The values for lobule dimensions were relatively consistent across genders, with small variations that did not reach statistical significance. lobule length and width, this is primarily genetically determined. This is why certain trends, such as slight differences in size between males and females, are often observed globally. For instance, studies like those of [14] indicate that males tend to have slightly larger lobular dimensions (including auricular), but this difference is not statistically significant.

5. CONCLUSION

This study investigated the morphometry and morphology of the external ear among the Omuma people of Rivers State, Nigeria. The results of this study revealed that free earlobes occurred more frequently than attached earlobes and earlobe attachment did not demonstrate any significant correlations with either gender or age group. Also, males had slightly higher lobule lengths and widths than females, but these differences were not statistically significant. The findings of this study align with previous researches which demonstrated that genetic factors along with population-based genetics primarily influence earlobe attachment.

6. RECOMMENDATIONS

i. Future studies should include a larger and more diverse sample from different regions within Etche to enhance the generalizability of the findings.
ii. Comparative studies with other ethnic groups and populations should be conducted to identify similarities and differences in ear morphometry and morphology.
iii. More advanced methods, such as 3D scanning and imaging, are recommended in future studies to collect more accurate and detailed data on ear morphology.

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