



# **Auricular Anthropometry of Indigenes of Uturu, Abia 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 auricle is an important cephalofacial part of the human body that is of forensic importance that portrays information about one's age, sex, race and ethnic group.

**Aim:** This study was therefore conducted to establish auricular anthropometric data and sexual dimorphic parameters of Uturu indigenes in Southeastern Nigeria.

**Materials and Methods:** A total of 370 subjects (185 males and 185 females) of Uturu indigenes who met the inclusion criteria were enrolled in the study. Auricular measurements which include auricular length and width and lobular length and width, as well as lobular attachments were obtained in inches. Data obtained was analyzed using SPSS version 23.0.

**Results:** Total mean auricular length, auricular width, lobular length and lobular width in males was 2.11, 1.35, 0.66 and 0.46 respectively while same parameters in females were 2.06, 1.22, 0.66 and 0.44 respectively. No significant sexual dimorphism was observed in the measured parameters

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except for auricular width ( $P=0.01$ ). Free earlobe was prevalent (68.92%:  $n=255$ ) in the study population especially among the female subjects.

**Conclusion:** The mean values for all auricular measurements were higher in males than in females except for lobular length which was the same in both sexes. Results The findings from this study provide useful evaluation of the auricular morphological characteristics among the study population will be useful in the documentation of auricular morphometric data, especially within Nigerian population.

*Keywords: Auricular morphology; Southeast Nigeria; sexual dimorphism; physical anthropometry.*

## 1. INTRODUCTION

The auricle is a part of the external ear which is visible on lateral aspect of the head bilaterally. It functions to receive and direct sound waves into the external auditory meatus, the other part of the external ear [1]. The auricle which is also known as the pinna, has several parts like the outer curvature, the helix, the anti-helix which is an inner curvature parallel to the helix, the tragus and anti-tragus found around the beginning of the external acoustic meatus and the concha, a depression that leads to the external acoustic meatus where sound waves pass to get to the middle and inner ear [2]. Most part of the auricle is made of elastic cartilage while the inferior most area, the lobule is entirely fatty tissue. The ear lobule can be either free or attached in relation to the face and this pattern has been shown to be an inherited morphogenetic trait [3].

The auricle is not just used for capturing and directing sound waves, but is also useful in facial aesthetics [4]. The shape and attachment of the auricle is important in the facial physiognomy for the determination of an individual's beauty [5]. Auricular measurement can be used in the production of prosthetics for a person either born without an auricle, a deformed auricle or involved in any form of auricular trauma [6,7]. With the growing technology, tech companies also use auricular measurements in development of hearing aids and ear phones of various sizes from as large as the head phone to as small as the recent air pods [8,9]. Measurements of the auricle is used in forensic anthropology in determining age, sex and race of an unknown body remains. Documentation of auricular anthropometry for different sex, race and ethnicity is valuable in forensic science as the auricle and its print, just like finger and lip prints, are unique to each individual [10,11].

For identification purposes and product design suitable for various populations, anthropometric data is needed [12]. Auricular measurements

have been carried out in different populations such as Sudan [13], Korean [9], Egypt [14], Chinese [15], Indian [11], and Thai [16]. In Nigeria such measurements have also been done in various tribes such as Ijaws [17], Hausas [12], Yoruba [18], Urhobos [19] Okrika [20], and Igbos [21]. There is paucity of data from the Igbo tribe; therefore, this study was done to evaluate the auricular morphometry and sexual dimorphism of Indigenes of Uturu community.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out in Uturu, a community in Isiukwuato Local Government Area of Abia state, Southeast, Nigeria.

### 2.2 Study Population

A systematic sampling technique was used to obtain participants for this study. A total of 370 participants, 185 males and 185 females, were used for this study. The aim and significance of the study was carefully explained to the participant, thereafter informed verbal consent was received from the participants.

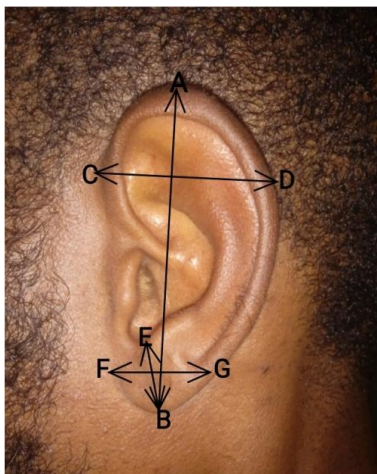
### 2.3 Inclusion and Exclusion Criteria

The participants whose parents and grandparents were Igbos of Uturu origin were included in the study. Participants with congenital ear anomalies, past or current auricular trauma and not of Uturu origin were excluded from the study.

### 2.4 Data Collection

With the subjects sitting in the Frankfurt horizontal position, using a digital vernier caliper, measurements of the auricle were taken according to the method of Singh et al. [4]. Auricular length (AL) was taken as the distance between the superior aspect of the helix and the

inferior aspect of the ear lobule. Auricular width (AW) was taken as the distance between the root of the auricle and the maximum convexity of the helix. Lobular length (LL) was taken as the distance between the basal tragal notch and the inferior end of the lobule. Lobular width (LW) was taken as the horizontal width of the lobule (Fig. 1). The attachment of the lobule with respect to the face was also observed and recorded as either free earlobe or attached earlobe.



**Fig. 1. The human auricle showing auricular dimensions. A-B (auricular length); C-D (auricular width); E-B (lobular length); F-G (lobular width)**

### 2.5 Data Analysis

All data obtained was analyzed using SPSS version 23. Independent t-test was done to compare the variables and determine sexual dimorphism while Pearson's correlation was used to determine the correlation between auricular dimensions. Results were expressed as mean and standard deviation.

### 3. RESULTS

Results from Table 1 showed that the males had higher mean values for auricular length ( $2.11 \pm 0.19$ ), auricular width ( $1.35 \pm 0.20$ ) and lobular width ( $0.46 \pm 0.10$ ) than auricular length ( $2.06 \pm 0.26$ ) and width ( $1.22 \pm 0.15$ ) and lobular width ( $0.44 \pm 0.09$ ) mean values of the females. The mean values for lobular length was the same for both genders (Male =  $0.66 \pm 0.13$ ; Female =  $0.66 \pm 0.12$ ) (Table 1).

Table 2 showed a statistical significant ( $t=2.97$ ;  $P=0.01$ ) sexual dimorphism between the auricular width of both males and females. No

sexual dimorphism was observed in the auricular length and lobular length and width between both genders.

In Table 3, significant positive correlation was only observed between the lobular length and lobular width ( $r = 0.41$ ;  $p = 0.01$ ) in males. In females, significant positive correlation was observed in the auricular length and auricular width ( $r = 0.35$ ;  $p = 0.03$ ), auricular length and lobular length ( $r = 0.43$ ;  $p = 0.01$ ) and lobular length and lobular width ( $r = 0.63$ ;  $p = 0.00$ ).

For distribution of the earlobe attachment pattern among the participants, out of 370 participants, 255 had free earlobe with females having a greater proportion (130) while 115 had attached earlobe with males having a greater proportion (60) (Table 4).

### 4. DISCUSSION

The present study aimed to provide anthropometric data of the auricles of Uturu indigenes in Southeast Nigeria. This study showed that mean values of auricular height in males (2.11) were higher than that of the females (2.06). This agrees with several reported studies in other populations [4,9,13] and also within Nigeria [12,21] but not with the reports of [18,22]. The higher male values may be as a result of increased muscle and bone cells due to testosterone in males [21]. The mean auricular width of the females was 1.22 while that of the males was 1.35 indicating also a higher value in males which is in tandem with the works of and [3,13,18]. Pearson's correlation showed a significant correlation between the auricular width of males and auricular width of females indicating a sexual dimorphism in auricular width. Sexual dimorphism in auricular width was also reported by other studies [11,20-21]. Although sexual dimorphism in auricular length was not observed in the current study, it was recorded in other populations [6,12,18].

The mean values of lobular height were the same in both sexes in this study. This differs from the report of those who reported higher values in males [3,4] and those who reported higher values in females [11,17]. The higher lobular length of females reported may be as a result of constant and earlier wearing of drooping earrings among females. Lobular width was greater in males and this agrees with the results of [4,7,11]. No sexual dimorphism was observed in both the length and width of the lobules of both

genders. This is in tandem with results of [11,19] but not with results of [7,20]. These variations may be attributed to geographical and social background differences.

**Table 1. Descriptive statistics of auricular dimensions of Uturu indigenes**

Auricular dimensions	N	Minimum (in)	Maximum (in)	Mean (in)	Std. Deviation
ALF	185	1.51	2.91	2.06	0.26
AWF	185	1.02	1.61	1.22	0.15
LLF	185	0.43	0.98	0.66	0.13
LWF	185	0.25	0.63	0.44	0.09
ALM	185	1.63	2.45	2.11	0.19
AWM	185	0.98	1.91	1.35	0.20
LLM	185	0.46	0.92	0.66	0.12
LWM	185	0.29	0.73	0.46	0.10

ALF = Auricular Length Female, AWF = Auricular Width Female, LLF = Lobular Length Female, LWF = Lobular Length Female, ALM = Auricular Length Male, AWM = Auricular Width Male, LLM = Lobular Length Male, LWM = Lobular Width Male, N = Number of subjects

**Table 2. Sexual dimorphism of auricular dimensions of Uturu indigenes**

	Ear lobe dimensions	N	Mean (in)	SD (in)	t-value	P-value	Inference
Pair 1	ALF	185	2.06	0.26	0.96	0.34	Not Significant
	ALM	185	2.11	0.19			
Pair 2	AWF	185	1.22	0.15	2.97	0.01	Significant
	AWM	185	1.35	0.20			
Pair 3	LLF	185	0.66	0.13	0.07	0.94	Not Significant
	LLM	185	0.66	0.12			
Pair 4	LWF	185	0.44	0.09	1.43	0.16	Not Significant
	LWM	185	0.46	0.10			

ALF = Auricular Length Female, AWF = Auricular Width Female, LLF = Lobular Length Female, LWF = Lobular Length Female, ALM = Auricular Length Male, AWM = Auricular Width Male, LLM = Lobular Length Male, LWM = Lobular Width Male, N = Number of subjects, SD = Standard Deviation

**Table 3. Correlation between auricular dimensions of Uturu indigenes**

PARAMETERS		ALF	AWF	LLF	LWF	ALM	AWM	LLM	LWM
ALF	R	1	0.35*	0.43**	0.19	0.14	0.02	-0.13	0.03
	P-value		0.03	0.01	0.26	0.42	0.89	0.45	0.85
AWF	R	0.35*	1	0.16	-0.11	0.21	0.00	-0.09	-0.01
	P-value	0.03		0.36	0.51	0.21	0.98	0.58	0.95
LLF	R	0.43**	0.16	1	0.63**	-0.04	-0.21	0.18	0.26
	P-value	0.01	0.36		0.00	0.81	0.22	0.28	0.12
LWF	R	0.19	-0.11	0.63**	1	-0.32	-0.11	0.14	0.16
	P-value	0.26	0.51	0.00		0.05	0.53	0.42	0.35
ALM	R	0.14	0.21	-0.04	-.319	1	0.24	0.27	0.17
	P-value	0.42	0.21	0.81	.055		0.14	0.11	0.30
AWM	R	0.02	0.00	-0.21	-0.11	0.24	1	0.11	-0.06
	P-value	0.89	0.98	0.22	0.53	0.14		0.53	0.70
LLM	R	-0.13	-0.09	0.18	0.14	0.27	0.11	1	0.41*
	P-value	0.45	0.58	0.28	0.42	0.11	0.53		0.01
LWM	R	0.03	-0.01	0.26	0.16	0.17	-0.06	0.41*	1
	P-value	0.85	0.95	0.12	0.35	0.30	0.70	0.01	

ALF = Auricular length Female, AWF = Auricular width female, LLF = Lobular length female, LWF = Lobular length female, ALM = Auricular length male, AWM = Auricular width male, LLM = Lobular length male, LWM = Lobular width male, r = Pearson correlation, \* = correlation is significant at the 0.05 level (2-tailed), \*\* = correlation is significant at the 0.01 level (2-tailed)

**Table 4. Distribution of earlobe attachment among Uturu indigenes**

Parameters	Gender		Free		Attached	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Female	185	50	130	70.27	55	29.73
Male	185	50	125	67.57	60	32.43
Total	370	100	255	68.92	115	31.08

Earlobe attachment is a morphogenetic trait of Mendelian inherited pattern with free or unattached earlobe being the dominant trait [23,24]. The free earlobe was the higher trait recorded in this study with females having more free earlobes than males. This in conformity with previous results [25,26], but not with [27] who recorded higher frequency of free earlobes in males.

## 5. CONCLUSION

Auricular length, auricular width and lobular length were higher in males than females with auricular width exhibiting significant sexual dimorphism. Males had a higher percentage of attached ear lobes while females had higher percentage of free ear lobes. Results from this study have provided added auricular morphometric data, particularly of the Igbo tribe, which will be useful to forensic anthropologists, plastic surgeons and medical technicians.

## CONSENT AND ETHICAL APPROVAL

Informed verbal consent was received from the participants. Study was approved by the Department of Anatomy of Gregory University Uturu, Abia state, Nigeria and study was performed in accordance to the Helsinki declaration.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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