Auricular anthropometry of indigenes of Uturu, Abia state, Nigeria


## ABSTRACT

Introduction: the auricle is an important part of the face that is of forensic importance that portrays information about one's age, sex, race and ethnic group. This study was therefore conducted to establish auricular anthropometric data and sexual dimorphic parameters of Uturu indigenes in Southeastern Nigeria.

Material 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 gotten was analyzed using SPSS version 16.0.

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 except for auricular width (P=0.01). Free earlobe was more prevalent (n=255) in the studied population with females (n=130) having more free earlobes than males.

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 from this study will be useful in the documentation of auricular morphometric data, especially within Nigerian population.



Key words: Auricular, Morphometry, Uturu, Sexual dimorphism, Ear anthropometry

## INTRODUCTION

The auricle is a part of the external ear visible on lateral aspect of the head bilaterally. It acts to capture 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 inferiormost 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 provide more auricular morphometric data for the Igbo tribe.

## MATERIALS AND METHODS

### Study area and subjects

The study was carried out in Uturu, a community in Isiukwuato Local Government Area of Abia state, Nigeria. A total of 370 participants, 185 males and 185 females, were used for this study. The participants' parents and grandparents were of Uturu origin. Participants with congenital ear anomalies, past or current auricular trauma and not of Uturu origin were not included in the study. The aim and significance of the study was carefully explained to the participant, thereafter verbal consent was received from the participants.

### Data collection

With the subjects sitting in the Frankfort 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 (Figure 1). The attachment of the lobule with respect to the face was also observed and recorded as either free earlobe or attached earlobe.

All numerical data obtained was analyzed using SPSS version 16. Independent t-test was done to analyze sexual dimorphism in auricular dimensions while Pearson's correlation was used to determine the correlation between auricular dimensions. Results were expressed as mean and standard deviation.

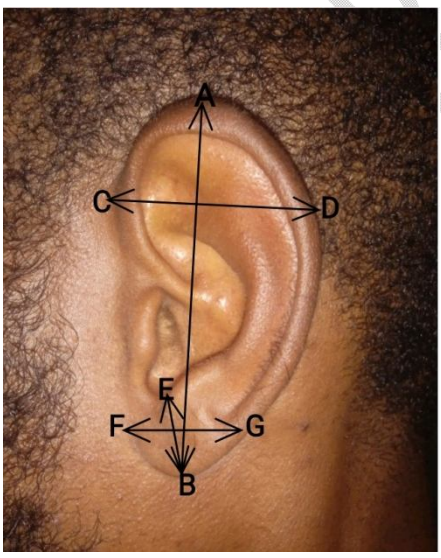


Fig 1 Auricular measurements. A-B (auricular length); C-D (auricular width); E-B (lobular length); F-G (lobular width).

## RESULTS

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

**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 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.

**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.*

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).

**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).*

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).

**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 |

## 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.

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.

## 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. No significant sexual dimorphism was observed in all measured parameters except for auricular width. Results from this study will be useful in the documentation of auricular morphometric data, especially within Nigerian population.

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