Original Article

An anthropometric study of the normal auricle of Cross River State indigenes of Nigeria

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A B S T R A C T

Introduction: To analyse and document anthropometric parameters of the normal human auricle among Nigerians of Cross River State origin as well as to evaluate sexual dimorphism and auricular growth variation among the age groups of this population.
Methods: The present study was carried out on 217 adult volunteers made up of 117 females and 100 males, within the age range of 21–60 years; with no evidence of congenital ear anomalies or previous ear surgeries. All subjects were indigenes of Cross River State and were randomly selected across the three senatorial districts of the State. Standard measurement procedures were followed to obtain the following Auricular parameters: Auricular Length (AL), Auricular Width (AW), Lobular Length (LL), Lobular Width (LW), Protrusion at Supra-Aurale (PS) Protrusion at Tragus (PT), Auricular and Lobular Indices.
Results: This study revealed that the mean Lobular length and Protrusion at Supra-aurale values are sexually dimorphic at age group of 21–30 while the Auricular length where sexually dimorphic at 21–30 and 31–40 years age groups with higher values noted in males than in females. Other parameters measured were not sexually dimorphic.
Discussion: Standard anthropometric methods where employed in carrying out this study, hence this result is recommended to Plastic Surgeons who may need to rectify any auricular abnormalities involving patients from this ethnic group.
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1. Introduction

Anthropometry is the study of the variation in the measurements of the human body and the data collated thereof is useful in the realm of reconstructive plastic surgery, prosthetics and ergonomics.[1,2]

Since the nineteenth century and even recently, Anthropometrists have engaged in the measurement of the human auricle.[3–5]

The auricle is not only useful for sound wave collation; it is also a facial feature that contributes enormously to the aesthetics of the face. The appearance of the auricle gives swift information about age and gender[6] as well as an unmistakable insight to genetic abnormalities.[7] Apparently, the positional appearance or deformation of the auricular shape and size may represent a possible anomaly.[8–10]

Over the years, several studies on the anthropometric study of the normal human auricle have reported age dependent changes in the auricular dimension specific to a particular people as well as sexual dimorphism.[11–13] More so, the morphological variation of the human auricle has been shown to play important role in forensic identification of unknown bodies.[14,15]

Nevertheless, recent reports of sexual dimorphism from the anthropometric auricular studies amongst different ethnic groups in Nigeria reveals variation in auricular parameters peculiar to each group.[4,5,16]

This study aims to establish auricular anthropometric values; investigate the extent of auricular sexual dimorphism; and variations with respect to growth patterns with advancing age among Cross River State indigenes of Nigeria.

It is our hope that data generated from this study would be relevant in creating an auricular data base which would be of immense help in forensic crime detection and an objective reference material for the aesthetic plastic surgeon and biological anthropometry researchers.

Cross River state is located in the southern part of Nigeria. The state is endowed with three major ethnic groups which include: the Effiks, the Ejaghams, and the Bekwaras.

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2. Methodology

2.1. Subjects and location

The present study was carried out on 217 adult volunteers made up of 117 females and 100 males, within the age range of 21–60 years; with no evidence of congenital ear anomalies or previous ear surgeries. All subjects were indigenes of Cross River State and were randomly selected from the three senatorial districts of the state. The age and sex were recorded against each volunteer and their informed consent was obtained from each volunteer before inclusion to the study. The adopted strict inclusion criteria for this study include: All volunteer subjects to be used must be indigenes of Cross River State; must not have any auricular deformities; must not have any auricular injury or trauma; Subjects must fall between 21–60 years of age; and their parents must both hail from Cross River State.

2.2. Anthropometric measurements of the auricle

Measurements were taken using the modified standardized landmarks.[19,6] Measurements of Auricular Length (AL), Auricular Width (AW), Lobular Length (LL) and Lobular Width (LW) were done using an electronic digitalized caliper that read to the nearest 0.01 mm. Protrusion at Supra-aurale and Protrusion at Tragus were measured using a geometrical set square that was calibrated in millimeters (mm). The anthropometric parameters landmarks are shown in Fig. 1.

2.2.1. Auricular length and width

The Auricular Length was measured as the straight distance between super-aurale (highest point on the auricle) and subaurale (deepest point on the free margin of ear lobule) as shown in Fig. 2(A) while the Auricular Width was measured as the straight distance between preaurale and postaurale as shown in Fig. 2(B).

2.2.2. Lobular length and width

The Lobular Length was measured as the distance between incisura intertragica inferior and subaurale, as shown in Fig. 3(A)
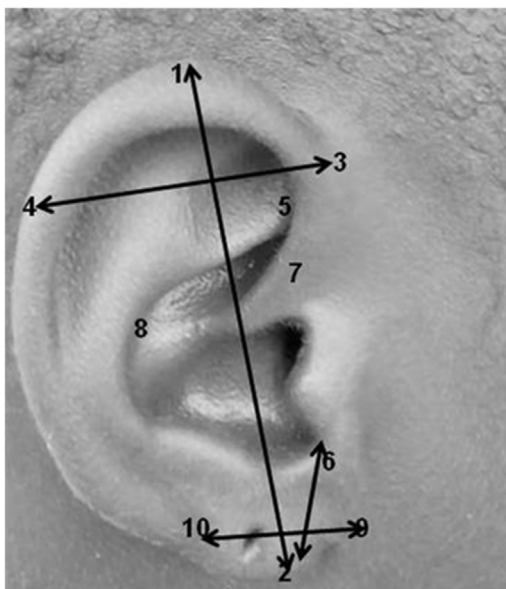
while the Lobular Width was measured as the distance between lobule anterior and lobule posterior, as shown in Fig. 3(B).

2.2.3. Protrusion at supra-aurale and tragal levels

The heights of auricular protrusions were measured with a geometrical set square with its base touching the temporal bone. The vertical limb of the set square thus measures the perpendicular distance between the posterior helical border at the level of superaurale and the temporal bone for PS (Fig. 4A) and at tragal level and the mastoid area for PT (Fig. 4B).

2.2.4. Auricular index and lobular index

Width and length of the auricle and lobule was incorporated into their respective indices to assess their proportion in various age groups as shown below.

Auricular Index = width of auricle × 100/length of auricle

Lobular Index = lobular width × 100/lobular length.

3. Result

In this study, the auricle parameters of two hundred and seventeen (217) subjects were measured (Male = 100 and Female = 117). Mean of the Auricular Length (AL), Auricular Width (AW), Lobular Length (LL), Lobular Width (LW), Protrusion at Supra-aurale and Protrusion at Tragus were recorded while the Auricular Index and Lobular Index were calculated. Data obtained were subjected to statistical analysis. Independent t-test was used for gender variation while Pearson's correlation was used for determination of study variables. The statistical package used was SPSS version 16. $P < 0.05$ was considered statistically significant. Results are expressed as mean $\pm$ SD. All measurements are given in centimeters.

Results of the Auricular length, Lobular length and Protrusion at Supra-aurale showed that there were significant difference ($P < 0.05$) between males and females values at age 21–30 while at age 31–40 only the Auricular length value show significant difference between the males and females (Table 1). The study therefore revealed that the mean Auricular length, Lobular length and Protrusion at Supra-aurale values are sexually dimorphic with higher values noted in males than in females. It was also observed that there were no significant differences in the male and female values of the Auricular width, Lobular width (LW) and Protrusion at tragus (PT) for all age groups ($P < 0.05$). The Auricular parameters across the entire cohort showed no significance difference with respect to advancing age.

4. Discussion

This study which focused on normal auricles is in line with the aim of this study as it tries to bring to the fore the variations of the auricle with a view to establish correlates for the forensic experts and a data base for the plastic surgeons involved with ear reconstruction.[16–18]

It is of particular interest to note that the mean value of AL in the present study approximates other Nigerian studies; among Maiduguri indigenes, 5.60 ± 0.52 cm[16] and among the people of South-South Nigerians, 5.57 ± 0.02 cm[19] However, with respect to sexual dimorphism, this result is at variance with the Nigerian studies outlined above.

Nevertheless, as closely related as the Nigerian data seems, it differs proportionally with that from several studies conducted on subjects with different ethnic backgrounds, including the one

Fig. 1. Anatomical landmarks of the auricle.
(1) superaurale, (2) subaurale, (3) preaurale, (4) postaurale, (5) concha superior (6) incisura intertragica inferior, (7) incisura anterior auris posterior, (8) strongest helical fold anthelical curvature, (9) lobule anterior, (10) lobule posterior.