The anthropometric measurement of the auricle In Igbo and Yoruba ethnic groups of the Nigerian adult population

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Abstract Background: The auricle is the visible part of the ear that resides outside of the head. The study was aimed at determining the mean values of the different anthropometric measurements from the right and left auricles between the Igbo and Yoruba ethnic groups of the adult Nigerian population.

Materials and Methods: These measurements were obtained from 182 females and 118 males from Igbo ethnic group and 95 females and 105 males of the Yoruba ethnic group between ages 18-68 years. A digital vernier caliper was used to measure the different parameters in each individual.

Results: The results showed the mean values for the auricular lengths, auricular widths and earlobe lengths at 95% confidence interval to be, respectively. 6.10±0.078, 3.24±0.059, 1.74±0.067 for the right auricle in Igbo males, 6.00±0.084, 3.29±0.055, 1.66±0.059 for the left auricle in Igbo males, 5.94±0.056, 0.01±0.047, 1.67±0.041 for the right auricle in Yoruba males, 6.16±0.08, 3.07±0.055, 1.76±0.059 for the left auricle in Yoruba males, 5.71±0.051, 3.07±0.043, 1.67±0.041 for the right auricle in Yoruba females, 5.78±0.05, 3.24±0.059, 1.74±0.067 for the left auricle in Yoruba females.

The differences in the auricular lengths, auricular widths and earlobe lengths measured between Igbo and Yoruba ethnic groups were statistically significant (p<0.05).

Conclusions: There are differences in the auricular lengths, auricular widths and earlobe lengths measured between Igbo and Yoruba ethnic groups which may be attributed to genetic and environmental factors.
2.79±0.067, 1.70±0.53 for the right auricle in the Yoruba females and 5.78±0.08, 3.05±0.047, 1.62±1.67 for the left auricle in the Yoruba females. There was no significant difference between all mean auricular lengths, and mean earlobe length of both auricles in both sexes of the Igbo and Yoruba ethnic groups when analysed with student t-test (p>0.05). However, the mean right auricular width in males and females of Igbo ethnic group was significantly higher than in individuals of Yoruba ethnic group (p<0.05).

Conclusion: The result of the study showed that all the auricular parameters that were measured were generally higher in males than in females which depict sexual dimorphism. It therefore implies that this information can be used in forensic identification.

Keywords: Length, width, earlobe, auricle, Igbo, Yoruba.

Introduction
Anthropometric study of the auricle is the concise measurement of the auricle. In some cases, it also involves taking note of certain characters that are of keen interest in the auricle in the course of the study. According to Bozkir et al., (1) auricular length, auricular width, earlobe length, and earlobe width are the main measurements been carried out in the anthropometric study of the auricle. Bozkir et al., (1) went ahead to define these parameters as follows: Lobular ear height (auricular length): Distance between the highest point of the auricle and the lowest point of the earlobe, Auricular width: Distance from the tragus to the helix, Lobular length (earlobe width): Distance from the intertragic notch or incisures to the caudal part of the lobule, Lobular width: Horizontal width of the lobule at the midpoint of the lobular height. A good knowledge of the anthropometry of the auricle is very essential for surgical treatment of congenital deformities and reconstruction of the auricle. (2) Advanced researches have also found anthropometric studies of the auricle useful in identification of photographs through ear prints. (2)

The anthropometric study of the auricle has been studied by scholars in various countries and different intervals. Most of the measurements that are obtained from these studies in other countries; such as India, Turkey and other European countries (3-13) have been applied in our country today.

Our knowledge of physical anthropology indicates some differing characteristics between Negroes of which Nigerians are inclusive and some other races (Caucasians, Mongoloids, Australoids). There are no sufficient literatures on auricular dimensions in Nigerian indigenous populations thus this study was done to fill the gap.

This study was done to investigate mean auricular lengths and widths, earlobe lengths of males and females between ages 18-68 years.

The auricle is the visible part of the ear that resides outside of the head. (14) The auricle is also referred to as the ‘pinna’. The auricle is made up a cartilaginous and non-cartilaginous part.

In Figure 1, the image of the pinna and the various parts are shown to further elaborate on the features under investigation.

![Anatomy of the Pinna](image)

Figure 1: Anatomy of the Auricle/ pinna. (15)

The cartilaginous part is composed of an irregularly shaped plate of cartilage that is covered by thin skin. (15) The non-cartilagenous is called earlobe. The earlobe is in the lowermost part of the external ear, it projects below the antitragus. The average earlobe is about 2cm long and elongate slightly with age. (16)

Human earlobe may be free or detached (hanging free from the head). Whether the earlobe is free or attached is a classic example...
of simple genetic dominance relationship. Freely hanging earlobes are the dominant allele while the attached are recessive.\(^{(16)}\)

In Figure 2, the examples of attached and detached earlobes are shown to further buttress the difference between both patterns (Nonpendulous and pendulous attachments).

![Figure 2(a&b): Non pendulous and (b) pendulous earlobes.\(^{(17)}\)](image)

The auricle has two surfaces: A lateral or anterior surface and medial or posterior surface (cranial surface). The auricle projects from the side of the skull at varying degrees; so the cranial surface of the auricle might be hidden in some individuals.\(^{(17)}\)

In Figure 3 below, the two surfaces of auricle are indicated (anterior and posterior surfaces).

![Figure 3: Pinna.\(^{(18)}\)](image)

The body of the auricle is covered by elastic and fibrous cartilage and skin. The cartilage of the auricle is called cartilagoauriculae. It is connected to the surrounding parts by ligaments and muscles.\(^{(18)}\)

The skin is thin, closely adherent to the cartilage, and covered with fine hairs furnished with sebaceous glands, which are numerous in the concha and scaphoid fossa. On the tragus and antitragus the hairs are strong and numerous. The skin of the auricular is continuous with that lining the external acoustic meatus.\(^{(19)}\)

This cartilage is also called cartilagoauriculae. The cartilage of the auricle is C-shaped. It consists of a single piece, it gives form the auricular part of the ear, and upon its surface are found the eminences and depressions described above.

It is absent in the lobule; also it is absent between the tragus and beginning of the helix, the gap is being filled up with dense fibrous tissue.\(^{(20)}\)

In Figure 4, the cartilage of the auricle is shown with its parts properly labelled and indicated.

![Figure 4: Cartilage of the Auricle.\(^{(21)}\)](image)

The ligaments of the auricle consist of two sets: Extrinsic ligaments and intrinsic ligaments.\(^{(22)}\)

The extrinsic ligaments connect the auricle to the side of the head. The extrinsic ligaments are two in number. They are namely: Anterior ligament, posterior ligament. The anterior ligament extends from the tragus and spina helicis to the root of the zygomatic process of the temporal bone while the posterior ligament passes from the posterior surface of the concha to the outer surface of the mastoid process.\(^{(22)}\)

A group of strong band, stretching from the tragus to the commencement of the helix, completing the meatus in front, and partly encircling the boundary of the concha; a band between the antihelix and the caudahelicis.\(^{(22)}\)

The muscles of the auricle are grouped into two types, namely: Extrinsic and intrinsic
muscles. The extrinsic muscles of the auricle connect the auricle with the skull and scalp, and move the auricle as a whole. The intrinsic muscles extend from one part of the auricle to another. The extrinsic muscles of the auricle include: auricularis superior, auricularis anterior and auricularis posterior. The intrinsic muscles of the auricle include: Helicis major, helicis minor, antitragicus, transversusauriculae, tragus and obliquus auriculæ. The auricle arises from a series of elevations termed auricular hillocks of Hiss around the first pharyngeal cleft. The auricular hillocks appear as elevations on the first and second pharyngeal arches. Three elevations on the first pharyngeal arch (mandibular arch) and three elevations on the second pharyngeal arch (hyoid). These auricular hillocks are seen at the sixth week of intrauterine life. Materials and Methods The study was descriptive and analytical. A total of 500 subjects which comprised 300 Igbos (182 females, 118 males) and 200 Yorubas (95 females, 105 males) between the ages 18 and 68 years randomly selected. All subjects used for this study were pure indigenes of the tribes (Igbo and Yoruba) both in Southern Nigeria with no history of auricular trauma or congenital deformities. Ethical clearance was obtained from the Research Ethics Committee of the University of Port Harcourt, Nigeria. The informed consent was obtained from the volunteer subjects before commencement of the study from March 10 – November 11, 2010. The subjects were grouped into five age range: 18–28 yrs, 29–38 yrs, 39–48 yrs, 49–58 yrs, and 59–68 yrs. Each subject was asked to take a sitting position on a chair, the auricular length, width and earlobe lengths were measured using digital vernier caliper as depicted by Bozkiret et al. The auricular length was measured by placing the digital vernier caliper vertically on the auricle, and the distance between the highest point of the auricle and the lowest point of the earlobe was read from the caliper. Auricular width was measured by placing the caliper horizontally, and the distance from the tragus to the helix was read from the caliper. The earlobe was measured by placing the caliper vertically, and the distance from the intertragic notch to the caudal part of the earlobe was read. The earlobe was examined for the presence of Darwinian Tubercle and the mode of earlobe attachment. Results In Table 1, males in both tribes were seen to have higher mean values of auricular length, auricular width and earlobe length than the females.

<table>
<thead>
<tr>
<th></th>
<th>Auricular Length (cm) Mean±1.96 S.E</th>
<th>Auricular Width (cm) Mean±1.96 S.E</th>
<th>Earlobe Length (cm) Mean±1.96 S.E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Igbo males, right auricle</td>
<td>6.10±0.078</td>
<td>3.24±0.059</td>
<td>1.74±0.067</td>
</tr>
<tr>
<td>Igbo males, left auricle</td>
<td>6.00±0.084</td>
<td>3.29±0.055</td>
<td>1.66±0.055</td>
</tr>
<tr>
<td>Igbo females, right auricle</td>
<td>5.94±0.059</td>
<td>3.01±0.047</td>
<td>1.67±0.042</td>
</tr>
<tr>
<td>Igbo females, left auricle</td>
<td>5.71±0.051</td>
<td>3.07±0.043</td>
<td>1.60±0.037</td>
</tr>
<tr>
<td>Yoruba males, right auricle</td>
<td>6.16±0.084</td>
<td>3.07±0.054</td>
<td>1.76±0.090</td>
</tr>
<tr>
<td>Yoruba males, left auricle</td>
<td>6.00±0.094</td>
<td>3.29±0.053</td>
<td>1.68±0.057</td>
</tr>
<tr>
<td>Yoruba females, right auricle</td>
<td>5.95±0.073</td>
<td>2.79±0.067</td>
<td>1.70±0.053</td>
</tr>
<tr>
<td>Yoruba females, left auricle</td>
<td>5.78±0.080</td>
<td>3.05±0.047</td>
<td>1.62±0.057</td>
</tr>
</tbody>
</table>

In Table 2, although there was a marked difference in the parameters between the males in both tribes, these differences were not statistically significant except for right auricular width on comparison.
Table 2: Test of significance using Student’s t test between auricular measurements from Igbo and Yoruba males.

<table>
<thead>
<tr>
<th></th>
<th>Calculated T Value</th>
<th>Tabulated T Value</th>
<th>Level of Significance</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Auricular Length (cm)</td>
<td>0.723</td>
<td>1.960</td>
<td>p =0.12</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Left Auricular Length (cm)</td>
<td>0.000</td>
<td>1.960</td>
<td>p =0.08</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Right Auricular Width (cm)</td>
<td>2.930</td>
<td>1.960</td>
<td>p =0.01</td>
<td>Significant</td>
</tr>
<tr>
<td>Left Auricular Width (cm)</td>
<td>0.012</td>
<td>1.960</td>
<td>p =0.07</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Right Earlobe Length (cm)</td>
<td>0.312</td>
<td>1.960</td>
<td>p =0.09</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Left Earlobe Length (cm)</td>
<td>0.350</td>
<td>1.960</td>
<td>p =0.08</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

In Table 3, similarly, there were marked differences in the parameters between the females in both tribes, but these differences were also not statistically significant except for right auricular width.

Table 3: Test of significance using Student’s t test between auricular measurements from Igbo and Yoruba females.

<table>
<thead>
<tr>
<th></th>
<th>Calculated T Value</th>
<th>Tabulated T Value</th>
<th>Level of Significance</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Auricular Length (cm)</td>
<td>0.149</td>
<td>1.960</td>
<td>p =0.09</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Left Auricular Length (cm)</td>
<td>1.045</td>
<td>1.960</td>
<td>p =0.08</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Right Auricular Width (cm)</td>
<td>3.790</td>
<td>1.960</td>
<td>p =0.01</td>
<td>Significant</td>
</tr>
<tr>
<td>Left Auricular Width (cm)</td>
<td>0.430</td>
<td>1.960</td>
<td>p =0.11</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Right Earlobe Length (cm)</td>
<td>0.625</td>
<td>1.960</td>
<td>p =0.09</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Left Earlobe Length (cm)</td>
<td>0.420</td>
<td>1.960</td>
<td>p =0.07</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

Table 4, the values obtained from auricular indices indicated that the Igbos’ consistently had higher values on the right auricles than the Yorubas.

Table 4: Auricular indices of the right and left auricles in both males and females of Igbo and Yoruba extraction.

<table>
<thead>
<tr>
<th></th>
<th>Right auricle</th>
<th>Left auricle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Igbo</td>
<td>53</td>
<td>55</td>
</tr>
<tr>
<td>Male Yoruba</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Female Igbo</td>
<td>51</td>
<td>54</td>
</tr>
<tr>
<td>Female Yoruba</td>
<td>47</td>
<td>53</td>
</tr>
</tbody>
</table>

Discussions
The results of this study indicate that all the auricular measurements were observed to be generally higher in males than in females \((p<0.05)\). This is typical of sexual dimorphism. It implies the knowledge of auricular measurements could be used as a means of identification in forensics and anthropology. This result is in agreement with the findings of other authors\(^{1,4,8}\) who reported males as having higher auricular lengths, auricular width, and earlobe length for both auricles than females.

Results of the data obtained from the two ethnic groups showed that the mean auricular lengths and earlobe lengths of the right and left auricles were higher in both sexes of the Yoruba ethnic group than in the Igbos. Analysis using Student t-test showed there was no significant difference between these measurements obtained from both ethnic groups \((p>0.05)\). These are consistent with the results obtained by other researchers.\(^{1,2,12,20}\) However, the mean auricular widths of the Igbos were higher than the mean auricular widths of the Yorubas. This was only significant for the right auricular width for both males and females of both ethnic groups when analyzed with the Student t-test \((p<0.05)\). This also agrees with the findings of Barut and Aktunc.\(^{8}\)

The mean auricular and earlobe lengths were higher in the right auricle than the mean auricular and earlobe lengths of the left auricle in the both sexes of Yoruba and Igbo ethnic groups. This finding was in accordance to the work carried out by Bozkir et al.\(^{1}\) among Turkish adults; Barut and Aktunc\(^{8}\) among Turkish adults.
The auricular widths were also found to be generally higher in the left auricle than in the right auricle in both ethnic groups as had earlier been observed by Barut and Aktunc.\(^8\) Based on the calculation of auricular indices of both ears of both sexes in the Ibos and Yorubas, the left auricular indices were significantly higher than the right auricular indices as was observed by Barut and Aktunc.\(^8\)

The auricular indices were higher in males and females in the Igbo ethnic group than in females and males of the Yoruba ethnic group. The results of this study have established that the two auricles exhibit sexual dimorphism. It therefore implies that this information can be used in forensic identification especially where the sexes of individuals (victims) were not known and for anthropological studies as a baseline data for these tribes.

**Recommendation:** We suggest that more works be done on this subject in other tribes to have enough data for Nigerian indigenous populations.

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**Conflict of Interest:** None.

**Informed consent:** Obtained.

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Original Article
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