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Original Research Article **Human Anatomy**

Auricular Morphometry of Okrika Tribe in Rivers State, Nigeria

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Abstract

Background: The auricle is a complex part of the sensory organ, and is made of cartilage that is covered with skin. Its function is to capture sound. This study was aimed at knowing the auricular dimensions in Okrika tribe in Rivers state. ***Methods:*** Auricular parameters from 401 Okrika indigens from 18 years and above were measured using standard Vernier calliper. The Parameters were ear height (EH), ear width (EW), lobular height (LH) and the lobular width (LW) for both right and left ears with the head of the subject in Frankfort horizontal plane. ***Results:*** Data was analyzed using SPSS version 23.0. All the measured parameters were higher in males compared to females in both left and right ears, implying sexual dimorphism. The mean values of all measured parameters in males were higher on the right compared to the left. Except ear index (T = 0.83; P = 0.41), side differences were observed in all other parameters at $P < 0.05$. Hence auricular parameters are said to be asymmetrical. In females, the mean values of all measured parameters were higher on the right compared to the left. Except ear index (T = 0.95; P = 0.34) and lobular index (T = 1.30; P = 0.19), side differences were observed in all other parameters at $P < 0.05$. ***Conclusion*:** In this study, we observed that all measured parameters were higher in the right ear than in the left and also larger in males than females. This sex related differences were said to be sexually dimorphic. Therefore this study has provided anthropometric data for the okrika tribe, which will be useful in forensic science and ear reconstructive surgeries.

Keywords: Auricular, morphometry, Anatomy, Okrika, tibe, Rivers State.

INTRODUCTION

Background to the Study

The Okrika tribes are a group of indigenous people located in Rivers State of the South-South geopolitical zone of Nigeria. Their predominant occupation is fishing (Oladipo *et al*., 2009). Anthropometry is the measurement of the body dimensions of a human for the understanding of physical variations between individuals. The ear is a defining feature of the face which can be used in statistical data for forensics, apparel and product optimization (Deopa D *et al*., 2013).

The ear is an auditory organ which contributes to the aesthetics of the human face and also influences the appearance of an individual (Japatti, *et al*., 2018). The human ear is anatomically divided into three portions: External ear, Middle ear, Internal ear. The external ear is composed of the shell-like auricle (pinna), which collects sound, and the external acoustic meatus (ear canal), which conducts sound to the tympanic membrane (Moore *et al*., 2014). The skin of the pinna is rich in sebaceous glands, which serves to protect the ear from cracking. Like the middle ear, it serves only to conduct sound to the inner ear. It consists of the auricle and external acoustic meatus (or ear canal). At the bottom of the ear canal is the tympanic membrane which establishes the border between the external and middle ear (Jana, 2021). The auricle, also known as pinna, is a wrinkly musculocutaneous tissue that is attached to the skull and it functions to capture sound. The auricle is mostly made up of cartilage that is covered with skin. The auricle has two parts the medial (inner) and lateral (outer) part. The medial aspect of the ear lobe is attached to the skull and has no major practical significance, (Jana, 2021).

The lateral aspect is concave and presents numerous grooves and ridges. The outer rim of the

auricle is called the helix, which then inferiorly ends as soft tissue known as the lobule of auricle (or ear lobe). The helix has three parts: crus, spine, and tail. The crus are the anterosuperior convex arch of the helix, the spine the thick superior part of the helix, while the tail is continuous with the lobule. Parallel to the helix is another convex curvature referred to as the antihelix, which has two parts: the triangular fossa (Scaphoid fossa) bound by the crus of the helix and the antihelix; and the crura of the antihelix which is the widening of the antihelix directed posteriorly toward the helix. The center of the auricle has a fossa that is continuous with the external acoustic meatus called the concha of the auricle. This concha is covered with a triangular cartilaginous process called the tragus. The base of the tragus is attached to facial skin, whereas its apex partially covers the entrance to the external acoustic meatus, inferiorly to it hangs the lobule (earlobe). The lobule is devoid of cartilage and contains areolar connective tissue. A small projection from the tragus, called Darwin's tubercle, is present in a fraction of the population. It is homologous to the tip of the ears of pointy-eared mammals. Opposite to the tragus, there is also a cartilaginous elevation above the lobule called antitragus (Drake, *et al*., 2015). The auricle contains both intrinsic and extrinsic muscle attachments. Extrinsic ear muscles include the superior auricular (auricularis superior), anterior auricular (auricularis anterior), and posterior auricular (auricularis posterior) muscles, located as their name indicates about the pinna. They pull the ear upward, forward, and backward, respectively. The superior and anterior auricular muscles are both fan-shaped and originate in the epicranial aponeurosis (galea aponeurotica). The superior auricular muscle is the largest of the three extrinsic ones and inserts into a tendon attached to the auricle superiorly. The anterior auricular muscle is the smallest of the group; its fibers are slight and easily overlooked. It inserts into the anterior helix. The posterior auricular muscle is comprised of 2-3 fascicles originating from the mastoid (temporal bone) and inserting into the posteroinferior part of the concha. Three arteries participate in the supply of the auricle: the posterior auricular artery (branch of the external carotid artery), anterior auricular arteries (branches of the superficial temporal artery), and minor branches of the occipital artery. Veins that drain the auricle mirror the arteries (Jana, 2021). The tympanic membrane is vascularized by the branches of the maxillary artery (deep auricular, and anterior tympanic arteries), the stylomastoid artery (branch of the posterior auricular artery), and inferior tympanic artery (branch of the ascending pharyngeal artery) (Drake *et al*., 2015).

The external ear is innervated by both sensory and motor nerves. Sensory innervation to the external ear is supplied by both cranial and spinal nerves. Motor innervation to muscles of the external ear is supplied by branches of the facial nerve (CN VII) (Lorenzo, 2019).

MATERIALS AND METHODS

This study was a descriptive cross sectional study. Convenient sampling method was used to recruit 401 indigenes of Okrika (18 years and above) by both parents with no history of ear anomaly or previous ear surgery. Informed consent was also obtained from the participants. Thereafter a standard Vernier calliper was used to obtain the following ear parameters; ear height (EH), ear width (EW), lobular height (LH) and the lobular width (LW) for both right and left ears with the head of the subject in Frankfort horizontal plane. Non-indigenes of Okrika and indigenes with ear deformity were excluded from the study. Ear Height was measured from the highest point of the pinna to the lowest point of the pinna. Ear width was measured as the distance between the most anterior and posterior points of the external ear. Lobular height was considered as the measurement from the midpoint of the base of the intertragic notch to the lowest point of the lobule. Lobular width was measured as horizontal width of lobule. Data obtained were analyzed using statistical package for the social sciences (SPSS) version 23.0 and Microsoft excel data analysis tool pack (2019 edition). Continuous variables were presented as mean±SD, while categorical variables were presented in frequency and percentage. Sex differences were determined using independent sample T-test, while side differences were determined using Paired sample T-test. Confidence interval was set at 95% and $P < 0.05$ was considered statistically significant.

RESULTS

Table-1: Dsitribution of the subjects according to age categories

Age (years)	Number of subjects	Percentage
18 – 20	24	6.0
21 – 25	40	10.0
26 – 30	76	19.0
31 – 35	74	18.5
36 – 40	80	20.0
41 – 45	40	10.0
46 – 50	30	7.5
51 – 55	37	9.2

0.0 Distribution of the subjects according to age was presented in Table 1. 24 (6.0%) were 18 – 20 years old, 40 (10.0%) were 21 – 25 years old, 76 (19.0%) were 26 – 30 years old, 74 (18.5%), 80 (2%) were 36 – 40 years old, 40 (10.0%) years old, 40 (10.0%) were 41 – 45 years old, 30 (7.5%) were 46 – 50 years old and 37 (9.2%) were 51 – 55 years old.

Table-2: Descriptive statistics of auricular parameters in Okrika subjects

Parameters	Sex	N	Min	Max	Mean±SD	*T*-test		
						df	*t*-value	*P*-value
Right ear parameters								
Ear Height	Male	198	49.75	67.11	59.79±3.30	352.11	6.07	**0.00***
	Female	203	49.02	63.21	58.06±2.31			
	Total	401	49.02	67.11	58.92±2.96			
Ear Width	Male	198	3.63	38.12	31.64±2.77	363.00	5.49	**0.00***
	Female	203	15.88	36.62	30.30±2.05			
	Total	401	3.63	38.12	30.96±2.52			
Lobular Height	Male	198	13.54	34.57	18.13±1.88	399.00	5.91	**0.00***
	Female	203	13.96	33.51	17.06±1.72			
	Total	401	13.54	34.57	17.59±1.87			
Lobular Width	Male	198	12.00	22.70	16.36±1.51	369.98	7.23	**0.00***
	Female	203	12.00	18.64	15.39±1.16			
	Total	401	12.00	22.70	15.87±1.43			
Ear Index	Male	198	6.65	69.26	52.99±4.77	399.00	1.72	0.09
	Female	203	28.64	71.89	52.24±3.82			
	Total	401	6.65	71.89	52.61±4.32			
Lobular Index	Male	198	46.05	165.33	90.97±11.67	321.78	0.39	0.69
	Female	203	48.88	113.02	90.59±7.03			
	Total	401	46.05	165.33	90.78±9.59			
Left ear parameters								
Ear Height	Male	198	48.88	66.75	58.71±2.95	399.00	4.32	**0.00***
	Female	203	45.39	88.91	57.38±3.24			
	Total	401	45.39	88.91	58.04±3.17			
Ear Width	Male	198	26.42	56.12	30.87±2.36	294.67	5.73	**0.00***
	Female	203	26.66	35.32	29.79±1.23			
	Total	401	26.42	56.12	30.32±1.95			
Lobular Height	Male	198	13.15	28.04	17.46±1.79	399.00	5.54	**0.00***
	Female	203	12.60	29.72	16.43±1.92			
	Total	401	12.60	29.72	16.94±1.92			
Lobular Width	Male	198	11.94	22.75	15.39±1.36	382.38	5.95	**0.00***
	Female	203	12.01	19.72	14.65±1.13			
	Total	401	11.94	22.75	15.01±1.31			
Ear Index	Male	198	43.82	98.94	52.68±4.67	399.00	1.67	0.09
	Female	203	33.31	63.36	52.03±2.95			
	Total	401	33.31	98.94	52.35±3.90			
Lobular Index	Male	198	53.98	128.17	88.79±9.64	399.00	-1.15	0.25
	Female	203	45.49	117.70	89.86±8.95			
	Total	401	45.49	128.17	89.33±9.30			

** = Significant at P < 0.05, **N** = Number of subjects, **Min** = Minimum, **Max** = Maximum, **SD** = Standard deviation, **df** = degree of freedom*

In Table 2, descriptive statistics of auricular parameters was presented. For the right ear, all measured parameters were higher in male subjects compared to the females. Ear height (T = 6.07; P = 0.00), ear width (T = 5.49; P = 0.00), lobular height (T = 5.91; P = 0.00) and lobular width (T = 7.23; P = 0.00) showed sexual dimorphism.

For the left ear, except for lobular index (Male = 88.79 ± 9.64; Female = 89.86 ± 8.95), all other parameters were higher in males compared to females. Also, ear height (T = 4.32; P = 0.00), ear width (T = 5.73; P = 0.00), lobular height (T = 5.54; P = 0.00) and lobular width (T = 5.95; P = 0.00) showed sexual dimorphism.

Table-3: Side differences in auricular parameters in Okrika male subjects

Auricular Parameters	Paired Differences					Paired *T*-test		
	MD	SD	SE of MD	95% C.I of the Diff		df	*t*-value	*P*-value
				Lower	Upper			
Ear Height (right vs. left)	1.08	1.37	0.10	0.89	1.27	197	11.09	**0.00***
Ear Width (right vs. left)	0.77	2.97	0.21	0.36	1.19	197	3.67	**0.00***
Lobular Height (right vs. left)	0.67	1.74	0.12	0.42	0.91	197	5.37	**0.00***
Lobular Width (right vs. left)	0.97	1.06	0.08	0.82	1.12	197	12.86	**0.00***
Ear Index (right vs. left)	0.31	5.23	0.37	-0.42	1.04	197	0.83	0.41
Lobular Index (right vs. left)	2.18	10.53	0.75	0.71	3.66	197	2.91	**0.00***

***** = *Significant at P < 0.05,* ***EH*** *= Ear height,* ***EW*** *= Ear width,* ***LH*** *= Lobular height,* ***LW*** *= Lobular width,* ***EI*** *= Ear index,* ***LI*** *= Lobular index,* ***MD*** *= Mean difference,* ***SD*** *= Standard deviation,* ***C.I*** *= Confidence interval,* ***Diff*** *= Difference, df = degree of freedom*

Side differences in auricular parameters in male subjects was presented in Table 3. The mean values of all measured parameters were higher on the right compared to the left. Except ear index ($T = 0.83$; $P = 0.41$), side differences were observed in all other parameters at $P < 0.05$. Hence auricular parameters are said to be asymmetrical i.e. it differs from one side of the body to the other.

Table-4: Side differences in auricular parameters in Okrika female subjects

Auricular parameters	Paired Differences					Paired *T*-test		
	MD	SD	SE of MD	95% C.I of the Diff		df	*t*-value	*P*-value
				Lower	Upper			
Ear Height (right vs. left)	0.69	2.47	0.17	0.34	1.03	202	3.96	**0.00***
Ear Width (right vs. left)	0.52	1.63	0.11	0.29	0.74	202	4.52	**0.00***
Lobular Height (right vs. left)	0.63	1.56	0.11	0.41	0.85	202	5.75	**0.00***
Lobular Width (right vs. left)	0.74	0.86	0.06	0.62	0.86	202	12.29	**0.00***
Ear Index (right vs. left)	0.22	3.24	0.23	-0.23	0.67	202	0.95	0.34
Lobular Index (right vs. left)	0.73	8.02	0.56	-0.38	1.84	202	1.30	0.19

***** = *Significant at P < 0.05,* ***EH*** *= Ear height,* ***EW*** *= Ear width,* ***LH*** *= Lobular height,* ***LW*** *= Lobular width,* ***EI*** *= Ear index,* ***LI*** *= Lobular index,* ***MD*** *= Mean difference,* ***SD*** *= Standard deviation,* ***C.I*** *= Confidence interval,* ***Diff*** *= Difference, df = degree of freedom*

Side differences in auricular parameters in female subjects was presented in Table 4. The mean values of all measured parameters were higher on the right compared to the left. Except ear index ($T = 0.95$; $P = 0.34$) and lobular index ($T = 1.30$; $P = 0.19$), side differences were observed in all other parameters at $P < 0.05$. Hence auricular parameters are said to be asymmetrical i.e. it differs from one side of the body to another.

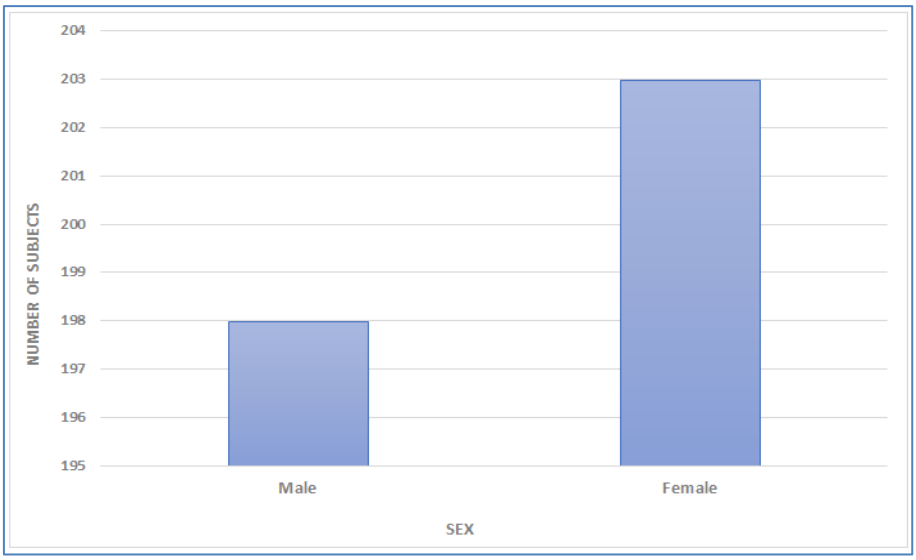

Fig-1: Distribution of the subjects according to sex, 198 (49.38%) of the subjects were males, while 203 (50.62%) were females

DISCUSSION

Ear Height

The ear reaches its mature height at 13 years in males and at 12 years in females (Ferrario *et al*., 1999). In this study it was discovered that males had a larger ear height compared to females. This is in agreement with previous study conducted by Edibamodu *et al*., (2019), on adult Ijaws in Bayelsa, he reported that the total ear height was larger in males than in females, with 58.40mm and 56.66mm in males and females respectively on the right ear while 58.14mm and 57.90mm on the left ear. Shireen and Karadkhelkar (2015) in their study on the auricle in India population, using 147 subjects, observed that all measured parameters were significantly larger in the right ear than the left. Japatti *et al*., (2018), who did a cross-sectional assessment on the normal adult human ear using the India population as a case study also observed that auricular dimensions in males were higher than that of females; 60.65 ±4.71mm in males and 58.69± 3.92mm in females for the right ear while 60.53 ±4.57mm and 58.38±3.57mm for male and female respectively on the left ear. This is an indication that this recent study is in agreement with previous studies. Hence in this present study sexual dimorphism was established. This present study also observed ear asymmetry in both males and females; the right ear is larger than the left. This is in conformity with a similar study carried out by Oladipo *et al*., 2017, in which they reported ear asymmetry (right ear bigger than left ear). However, in a study by Livia *et al.*, (2018), it was observed that the left ear was larger in dimension than the right ear, thus, it is not in agreement with this study.

Ear Width

The mean ear width, as observed in this study was 31.65 ±2.77mm for male and 30.30 ±2.05mm for females on the right ear, while on the left it is 30.87 ± 2.36mm for male and 29.79 ± 1.23mm for females. There is sexual dimorphism. Moreso this study is also in conformity with the studies of Oladipo *et al.*, 2017, Edibamodu *et al*., 2019, Shireen and Karadkhelkar (2015) and Japatti *et al*., 2018.

Lobular Height and Ear Width

In this study, sexual dimorphism was also observed in the lobular dimension with higher values in males than females.

CONCLUSION

Therefore the data presented in this study has provided anthropometric data for the Okrika tribe, which will be useful in forensic science, provision of prosthetic auricular moulds and ear reconstructive surgeries.

RECOMMENDATION

Further comparative studies with other tribes within and outside the State are needed to give a general picture of the auricular anthropometry in this region.

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