



## ANTHROPOMETRIC MEASUREMENT OF THE EXTERNAL EAR DIMENSION OF IJAWS IN RIVERS AND BAYELSA STATES

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Article Received on 07/04/2021

Article Revised on 28/04/2021

Article Accepted on 19/05/2021

### ABSTRACT

The aim of this study is to determine and document the mean external ear dimensions of adult Ijaws in Rivers and Bayelsa states of Nigeria. A total of 228 subjects comprising 148 subjects from Rivers State divided into 77 females and 71 males, and 80 subjects from Bayelsa State divided into 40 females and 40 males. A cross-sectional survey method with a quota sampling technique was adopted while the subjects were randomly selected from the study areas. It was ensured that selected subjects were not biracial or hybrid, had no history of previous ear surgery and were not heavy earring users. Statistical analysis was done using IBM SPSS (statistical package for the social sciences) version 23. Paired samples t-test was used to compare the mean of the right and left ear of a given sex. Results obtained were as follows: for the Rivers subjects, mean EL (R=55.38±3.73, L=55.22±3.89)mm, EW (R=26.75±5.99, L=26.99±2.62)mm, LL (R=16.42±1.58, L=17.31±1.45)mm, LW (R=13.09±2.07, L=14.41. ±2.77)mm EI (R=48.44±10.64, L=49.16±6.10)mm LI (R=80.48±14.85, L=26.15±5.36)mm for the males. Whereas for the female, EL (R=55.39±4.84, L=54.52±4.31)mm, EW (R=25.99±2.60, L=25.81±3.94)mm, LL (R=16.33±1.93, L=16.66±1.33)mm, LW(R=12.55±1.99, L=13.94±2.22)mm, EI (R=47.22±5.87 L=48.24±5.62)mm, LI (R=77.41±12.77, L=25.31±4.39)mm. For the Bayelsa subjects, EL (R=54.35±4.12, L=53.86±6.87)mm, EW (R=25.81±2.46, L=25.35)mm, LL (R=16.99±1.46, L=16.06±1.92)mm, LW (R=15.76±19.06, L=14.17±2.28)mm, EI (R=47.70±5.35, L=47.98±9.52)mm, LI (R=137.38±96.92, L=86.43±18.56)mm for the males whereas for the females, EL (R=56.65±5.05, L=55.61±5.46)mm, EW (R=26.03±3.09, L=25.32±3.34)mm, LL(R=16.27±1.54, L=16.07±1.74)mm, LW (R=12.96±2.32, L=13.84±2.37)mm, EI (R=46.31±6.77, L=45.95±7.80)mm and LI (R=80.31±16.17, L=86.63±15.35)mm. On comparison, Left Ear Width was found to be higher in Bayelsa males. This difference was statistically significant ( $\rho=0.00$ ). Among the Rivers subjects, the right ear length and lobular length were higher in males. This difference was statistically significant ( $\rho=0.00$ ). Ethnic variation was observed in left lobular length of females with mean value of the Rivers subjects being higher while for the males, ethnic variation was observed as Left Ear Width, Left Lobular Length and Left Lobular Index were found to be higher in Rivers males. This study will be useful in forensic human identification, surgery and product design.

**KEYWORDS:** Measurement, External, Ear Dimension, Ijaws, Rivers, Bayelsa.

### INTRODUCTION

The external ear (outer ear) consists of the auricle (pinna) and external acoustic meatus or ear canal. It picks sound energy and focuses it on the eardrum (tympanic membrane) which lies at the middle end of the external

ear and separates it from the middle ear. The auricle is the visible part of the ear that consists of yellow elastic cartilage which is thrown into folds and its one of the primary features of the human face.<sup>[1]</sup> Its subtle structures convey signs of age and gender, though not easily

defined.<sup>[2]</sup> They are the first series of stimulus modifiers in the auditory apparatus.<sup>[3]</sup> The external acoustic meatus extends from the pinna to the ear drum with a dimension of about 2.5cm (1in) in length and 0.7cm (0.3in) in diameter.

Anthropometric study shows that the shape, size and orientation of each external ear is unique as fingerprint.<sup>[4]</sup> The anthropometric use of the external ear started since late 19<sup>th</sup> century when Alphonse Bertillion utilized it as one of the eleven anthropometric measurements for his manual System of Identifying Individuals.<sup>[5]</sup>

A study aimed at detecting growth alterations after surgery for prominent ears was done. The cartilage excision technique was used in all 76 patients seen for follow-up. Two hundred students served as controls. Auricular measurements were done according to standardized guidelines of anthropometry. There was no significant difference in the retroauricular angle between the surgical group and controls. The morphologic ear length in the surgical group was significantly smaller than in controls. Maximum ear length was significantly greater in men.<sup>[6]</sup>

A study on the Anthropometry of the pinna among adult Nigerian Resident in Maiduguri metropolis was done using a total of 217 adult Nigerians aged 18-65years who met the inclusion criteria. Standardized measurements of the ear pinna (Total ear height, Lobular height and Lobular width) were measured using standard vernier callipers (Tresna, Japan) and a tape rule. Their study aimed at showing the morphological and aesthetic differences between males and females; as well as changes in ear morphology with age. In their results, the mean total ear height and mean lobular height were higher in males than in females while the females had a higher mean lobular width of 1.37cm than that of 1.33cm in males. The study showed that there were increases in earlobe height and lobular height but a decrease in lobular width with advancing in age. The study also showed that age related changes in ear morphology do exist in Nigerians and the changes were with respect to sex from adolescence to the age groups of 41-45years.<sup>[7]</sup>

Study on the morphometry of the human ear, using 420 patients or staff in Royal Free Hospital, London. The measured parameters were; head length and height, ear height and axis, antihelix taken off angle, earlobe length and width, ear width at the helical angle, conchal bowl depth and helical-mastoid distance using a vernier calliper and a simple device made from an insulin syringe (with the plunger removed) for the angular measurements. The study was aimed at examining the variation in the shape of the human ear according to age, sex and ethnic group with particular attention to ear prominence. The results obtained showed that good symmetry was shown for all measurements. It was found that there was a consistent trend in ear morphology depending on ethnic group, age and sex, this study was

unable to define an objective method of for assessing ear prominence.<sup>[8]</sup>

Work done on the anthropometric measurements of external ear of medical students in Uttarakhand region. The study aimed at determining the mean values of different measurement from right and left ears and at giving information about sex-related dimensions of ear, right-left symmetry, age –related changes. All ear dimensions were significantly higher in males than in females ( $p < 0.0001$ ) and a significant effect on age was found.<sup>[9]</sup>

There was little information on external ear dimension of ethnic and inter-ethnic groups in Nigeria, which made the use of external ear dimension as anthropometric tool for person identification in the region of the country under study unachievable. Hence, this study was aimed at determining the anthropometric measurement and variation of the external ear dimension between male and female Ijaws in Rivers and Bayelsa states.

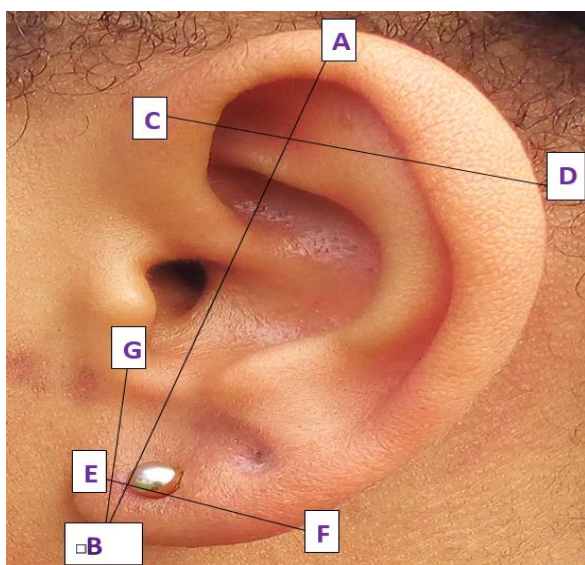
## MATERIALS AND METHODS

A total of 228 subjects aged 18-50 years which comprised of 117 (77 from Rivers and 40 from Bayelsa) females and 77 (71 from Rivers and 40 from Bayelsa) males was used for this study. A cross-sectional survey method with a quota sampling technique was adopted while the subjects were randomly selected from the communities used for the study. The selected subjects were not biracial or hybrid, no history of previous ear surgery and are not heavy earing users. Prior to the time of data collection, institutional ethical clearance was obtained from the ethical committee, University of Port Harcourt as well as informed consent from the community heads while the purpose of study was explained to the subjects as their willingness and cooperation was considered. The instruments used was validated by the project supervisor and co-students, hence, the subjects were randomly selected among the residents of the various communities picked from the states of study.

The bilateral sizes of the auricles were measured with vernier callipers using the following parameters; total ear height (TEH), ear width (EW), lobular height (LH) and the lobular width (LW) for each right and left ears of the subject when the head was in Frankfurt horizontal plane and also ear and lobule index was measured. These parameters were measured considering the following landmarks; distance between the superior most pinna points (supraurale) to inferior most point of the lobule (subaurale) for total ear height with the fixed part of the vernier caliper placed at the supraurale while the movable part was placed at the subaurale and the reading was taken (point-), distance between maximum convexity of the helix and the root of the ear (ear width-EW, point-) as the fixed part of vernier caliper was placed at the preaurale while the movable part was placed at the postaurale and the measurements was

(point) taken., distance between inferior most point of external ear attachment to the skin of the face (intertragic notch) to the free margins of the ear lobe (lobular height-LH, point-) was measured by placing the fixed arm of the vernier caliper at the intertragic notch while the movable arm was placed below and distance between outermost maximum transverse width of ear lobule and caudal most attachment of ear lobule (lobular width-LW, point-). The ear index and lobule index were calculated using the formular; ear width/ear height x 100 for ear index and lobule width / lobule height x 100 for lobule index. The vernier caliper was adjusted while taking the measurement until a good accuracy was met and recorded in millimeter (mm) and the process was repeated for each subject for consistency.

Data analysis was done using SPSS (statistical package for the social sciences) version 23 while comparison of the measurements taken from the right and left ear of a given sex was performed using paired samples t-test.



**Figure 1: The landmarks of the Ear height (AB), Ear width (CD), Lobular width (EF), Lobular height (GB).**

## RESULTS

Figure 1 shows subjects' distribution of Bayelsa state according to local government with majority of the population belonging to Ekeremor and the lesser from Silga. Figure 2 shows subjects' distribution of Rivers state according to local government with majority of the population belonging to Abonemma and Okrika, while the lesser from Opobo.

Table 1 shows the descriptive statistics of the measured variables in Bayelsa subjects. The mean age for males was  $32.33 \pm 9.74$ mm and  $31.08 \pm 10.80$ mm for females. The mean right ear length is  $54.35 \pm 4.12$ mm for males and  $56.65 \pm 5.05$ mm for females, while the width was  $25.81 \pm 2.46$ mm for males and  $26.03 \pm 3.09$ mm for females. The mean right lobular length for males and females was  $16.99 \pm 1.46$ mm and  $16.27 \pm 1.54$ mm while

the width was  $15.76 \pm 19.06$ mm for males and  $12.96 \pm 2.32$ mm for females. The right ear index for males and females was  $47.70 \pm 5.35$ mm and  $46.31 \pm 6.77$ mm while the lobular index for males and females was  $137.38 \pm 15.76$ mm and  $80.31 \pm 16.17$ mm. The mean left ear length for both males and females were  $53.86 \pm 6.87$ mm and  $55.61 \pm 5.46$ mm while the width for males and females was  $25.35 \pm 3.06$ mm and  $25.32 \pm 3.34$ mm. The males and females left lobular length was  $16.06 \pm 1.92$ mm and  $16.07 \pm 1.74$ mm while the left lobular width for males and females was  $14.17 \pm 2.28$ mm and  $13.84 \pm 2.37$ mm. The mean left ear index for males and females was  $47.98 \pm 9.52$ mm and  $45.95 \pm 7.80$ mm while the left lobular index was  $89.43 \pm 18.56$ mm for males and  $86.63 \pm 15.35$ mm for females. Table 2 shows the descriptive statistics of the measured variables in Rivers subjects. The mean age for males was  $29.82 \pm 9.4$ mm and  $30.59 \pm 10.31$ mm for females. Hence, the mean right ear length was  $55.38 \pm 3.73$  for males and  $55.39 \pm 4.84$  for females, while the right ear width was  $26.75 \pm 5.99$ mm for males and  $25.99 \pm 2.60$ mm for females. The mean right lobular length for males and females was  $16.42 \pm 1.58$ mm and  $16.33 \pm 1.93$ mm while the right lobular width for males was  $13.09 \pm 2.07$ mm and  $12.55 \pm 1.99$ mm for females. The right ear index for males and females was  $48.44 \pm 10.64$ mm and  $47.2 \pm 5.87$ mm while the right lobular index for males and females was  $80.48 \pm 14.85$ mm and  $77.41 \pm 12.77$ mm. The mean left ear length for both males and females  $55.22 \pm 3.89$ mm and  $54.52 \pm 4.31$ mm while the left ear width for males and females was  $26.99 \pm 2.62$ mm and  $13.94 \pm 2.22$ mm. The left lobular length for males and females  $17.31 \pm 1.45$ mm and  $16.66 \pm 1.33$ mm while the left lobular width for males and females was  $14.41 \pm 2.77$ mm and  $13.94 \pm 2.22$ mm. The mean left ear index for males and females was  $49.16 \pm 6.10$ mm and  $48.24 \pm 5.62$ mm while the left lobular index was  $26.15 \pm 5.36$ mm for males and  $25.31 \pm 4.39$ mm for females. Table 3 shows a T-test comparing the measured variables in Bayelsa subjects. It was observed that there was no statistically significant difference except for the right ear length ( $t = -2.23$ ,  $p = 0.03$ ) and the right lobular length ( $t = 2.13$ ,  $p = 0.04$ ). Table 4 represents a T-test comparing the measured variables in Rivers subjects (male and females). No statistically significant difference was observed in all major parameters except for the left ear width ( $t = 2.16$ ,  $p = 0.03$ ) and for the left lobular length ( $t = 2.86$ ,  $p = 0.00$ ). Table 5 shows paired T-test comparing the measured variables on both sides of Bayelsa males' subjects. Hence, there was a statistical difference of right lobular length to left lobular length ( $t = 2.56$ ,  $p = 0.01$ ). Table 6 shows paired T-test comparing the measured variables of both sides (right and left) in Bayelsa females. Right lobular width to left lobular width ( $t = -2.68$ ,  $p = 0.01$ ) and right lobular index to left lobular index ( $t = -2.67$ ,  $p = 0.01$ ) was observed to be statistically significant different. Table 7 shows paired T-test comparing the measured variables of both sides (right and left) in males from Rivers state. Statistically significant difference was

observed for right lobular length to left lobular length ( $t = -3.71, p = 0.00$ ), right lobular width to left lobular width ( $t = -3.25, p = 0.00$ ) and right lobular index to left lobular index ( $t = 28.30, p = 0.00$ ). Table 8 shows paired T-test comparing the measured variables on both sides of females from Rivers state. There was no statistically significant difference except for the right lobular width to the left lobular width ( $t = -4.10, p = 0.00$ ) and right lobular index to left lobular index ( $t = 31.80, p = 0.00$ ). Table 9 represents T-test comparing the measured variables in males of both ethnic groups (Bayelsa and Rivers). Hence, there was statistically significant difference for left ear width ( $t = -3.00, p = 0.00$ ), left lobular width ( $t = -3.89, p = 0.00$ ) and left lobular index ( $t = 27.38, p = 0.00$ ). Table 10 shows T-test comparing the measured variables in females of both ethnic group (Bayelsa and Rivers). The left lobular index ( $t = 24.72, p = 0.00$ ) was statistically different.

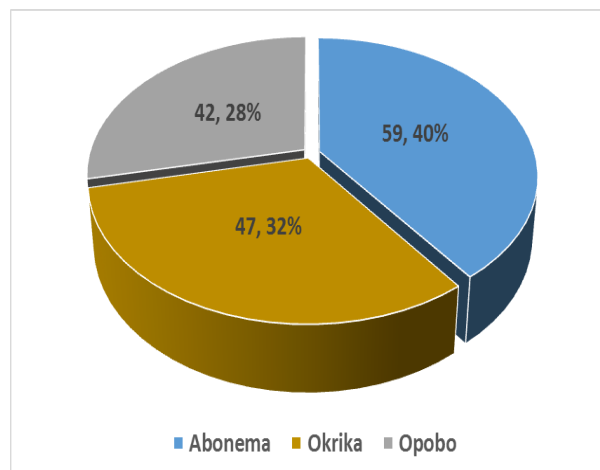


Figure 2: Distribution of the Subjects from Rivers according to Local Government Area.

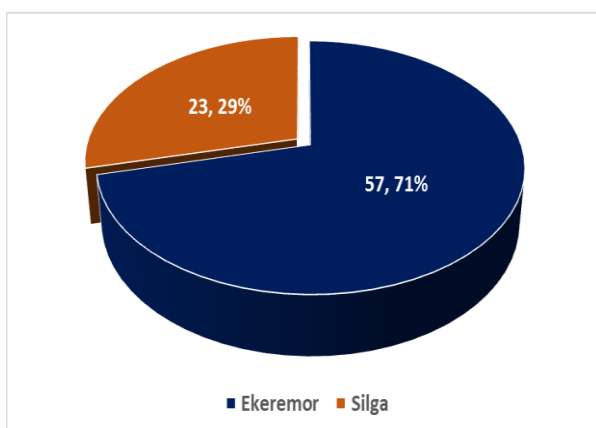


Figure 1: Distribution of the Subjects from Bayelsa according to Local Government Area.

Table 1: Descriptive statistics of the measured variables in Bayelsa Subjects (mm).

Parameters	Male [N = 40]			Female [N = 40]			Total [N = 80]		
	Mean±S.D	Min.	Max.	Mean±S.D	Min.	Max.	Mean±S.D	Min.	Max.
Age (years)	32.33±9.74	18.00	50.00	31.08±10.80	18.00	50.00	31.70±10.24	18.00	50.00
Right Ear Length	54.35±4.12	47.09	60.30	56.65±5.05	42.20	69.07	55.50±4.72	42.20	69.07
Right Ear Width	25.81±2.46	20.01	29.92	26.03±3.09	14.90	33.06	25.92±2.78	14.90	33.06
Right Lobular Length	16.99±1.46	14.11	19.28	16.27±1.54	12.03	18.39	16.63±1.54	12.03	19.28
Right Lobular Width	15.76±19.06	8.03	132.56	12.96±2.32	8.70	18.25	14.36±13.56	8.03	132.56
Right Ear Index	47.70±5.35	38.81	58.66	46.31±6.77	25.23	60.99	47.00±6.10	25.23	60.99
Right Lobular Index	96.92±137.38	44.69	939.48	80.31±16.17	48.88	119.79	88.62±97.55	44.69	939.48
Left Ear Length	53.86±6.87	24.10	63.82	55.61±5.46	39.78	69.00	54.74±6.23	24.10	69.00
Left Ear Width	25.35±3.06	20.01	31.02	25.32±3.34	20.00	34.10	25.34±3.18	20.00	34.10
Left Lobular Length	16.06±1.92	11.09	19.10	16.07±1.74	11.05	19.30	16.07±1.82	11.05	19.30
Left Lobular Width	14.17±2.28	9.81	18.12	13.84±2.37	8.37	18.97	14.00±2.31	8.37	18.97
Left Ear Index	47.98±9.52	34.72	92.07	45.95±7.80	34.21	75.39	46.96±8.71	34.21	92.07
Left Lobular Index	89.43±18.56	57.07	151.26	86.63±15.35	54.10	127.32	88.03±16.98	54.10	151.26

S.D = Standard Deviation, Mini = Minimum, Maxi = Maximum

**Table 2: Descriptive statistics of the measured variables in Rivers Subjects (mm).**

Parameters	Male [N = 74]			Female [N = 74]			Total [N = 148]		
	Mean±S.D	Mini	Maxi	Mean±S.D	Mini	Maxi	Mean±S.D	Mini	Maxi
Age (years)	29.82±9.84	16.00	49.00	30.59±10.31	16.00	49.00	30.21±10.05	16.00	49.00
Right Ear Length	55.38±3.73	47.31	60.30	55.39±4.84	42.20	69.07	55.39±4.31	42.20	69.07
Right Ear Width	26.75±5.99	19.92	58.00	25.99±2.60	20.01	33.06	26.37±4.62	19.92	58.00
Right Lobular Length	16.42±1.58	10.11	19.82	16.33±1.93	11.89	27.91	16.37±1.76	10.11	27.91
Right Lobular Width	13.09±2.07	8.82	18.71	12.55±1.99	8.20	17.03	12.82±2.04	8.20	18.71
Right Ear Index	48.44±10.64	34.91	99.96	47.22±5.87	34.76	60.99	47.83±8.59	34.76	99.96
Right Lobular Index	80.48±14.85	50.77	118.34	77.41±12.77	43.75	112.66	78.94±13.89	43.75	118.34
Left Ear Length	55.22±3.89	43.79	63.54	54.52±4.31	41.09	62.78	54.87±4.10	41.09	63.54
Left Ear Width	26.99±2.62	21.08	31.23	25.81±3.94	0.00	31.09	26.40±3.39	0.00	31.23
Left Lobular Length	17.31±1.45	13.45	19.98	16.66±1.33	13.09	19.23	16.98±1.42	13.09	19.98
Left Lobular Width	14.41±2.77	6.96	19.21	13.94±2.22	9.40	18.97	14.18±2.51	6.96	19.21
Left Ear Index	49.16±6.10	33.92	65.71	48.24±5.62	36.53	60.40	48.70±5.86	33.92	65.71
Left Lobular Index	26.15±5.36	11.81	37.64	25.31±4.39	16.89	37.81	25.73±4.90	11.81	37.81

S.D = Standard Deviation, Mini = Minimum, Maxi = Maximum

**Table 3: T-test comparing the measured variables in Bayelsa Subjects (Male and Female).**

Parameters	Mean Differences				t-test for Equality of Means		
	M.D	S.E.M.D	95% C.I of the Difference		t-value	Df	P-value
			Lower	Upper			
Age (years)	1.25	2.30	-3.33	5.83	0.54	78.00	0.59
Right Ear Length	-2.30	1.03	-4.35	-0.25	-2.23	75.02	<b>0.03*</b>
Right Ear Width	-0.22	0.62	-1.46	1.02	-0.36	78.00	0.72
Right Lobular Length	0.72	0.34	0.05	1.38	2.13	78.00	<b>0.04*</b>
Right Lobular Width	2.79	3.04	-3.25	8.84	0.92	78.00	0.36
Right Ear Index	1.39	1.36	-1.33	4.10	1.02	78.00	0.31
Right Lobular Index	16.62	21.87	-26.92	60.16	0.76	78.00	0.45
Left Ear Length	-1.75	1.39	-4.51	1.01	-1.26	78.00	0.21
Left Ear Width	0.04	0.72	-1.39	1.46	0.05	77.42	0.96
Left Lobular Length	-0.01	0.41	-0.82	0.81	-0.02	77.22	0.98
Left Lobular Width	0.33	0.52	-0.70	1.36	0.64	78.00	0.53
Left Ear Index	2.03	1.95	-1.85	5.91	1.04	78.00	0.30
Left Lobular Index	2.79	3.81	-4.79	10.38	0.73	78.00	0.47

M.D = Mean Difference, S.E.M.D = Standard Error of Mean Difference, C.I = Confidence Interval, \* = Significant

**Table 4: T-test comparing the measured variables in Rivers Subjects (Male and Female).**

Parameters	Mean Difference				t-test for Equality of Means		
	M.D	S.E.M.D	95% C.I of the Difference		t-value	Df	P-value
			Lower	Upper			
Age (years)	-0.77	1.66	-4.05	2.51	-0.46	146	0.64
Right Ear Length	-0.01	0.71	-1.42	1.39	-0.02	146	0.99
Right Ear Width	0.76	0.76	-0.74	2.26	1.00	146	0.32
Right Lobular Length	0.10	0.29	-0.48	0.67	0.33	146	0.74
Right Lobular Width	0.55	0.33	-0.11	1.20	1.63	146	0.10
Right Ear Index	1.23	1.41	-1.57	4.02	0.87	146	0.39
Right Lobular Index	3.07	2.28	-1.43	7.57	1.35	146	0.18
Left Ear Length	0.70	0.67	-0.63	2.04	1.04	146	0.30
Left Ear Width	1.19	0.55	0.10	2.27	2.16	146	<b>0.03*</b>
Left Lobular Length	0.65	0.23	0.20	1.11	2.86	146	<b>0.00*</b>
Left Lobular Width	0.47	0.41	-0.35	1.28	1.13	146	0.26
Left Ear Index	0.92	0.96	-0.99	2.82	0.95	146	0.34
Left Lobular Index	0.84	0.81	-0.75	2.43	1.04	146	0.30

M.D = Mean Difference, S.E.M.D = Standard Error of Mean Difference, C.I = Confidence Interval, \* = Significant

**Table 5: Paired T-test comparing the measured variables in on the Both sides (Right and Left) in Males from Bayelsa.**

Parameters	Paired Differences					Paired T-test		
	Mean	S.D	S.E.M.D	95% C.I of the Difference		t-value	df	P-value
				Lower	Upper			
Right EL - Left EL	0.49	7.56	1.19	-1.93	2.91	0.41	39.00	0.68
Right EW - Left EW	0.46	4.48	0.71	-0.98	1.89	0.64	39.00	0.52
Right LL - Left LL	0.93	2.29	0.36	0.19	1.66	2.56	39.00	<b>0.01*</b>
Right LW - Left LW	1.59	19.80	3.13	-4.75	7.92	0.51	39.00	0.62
Right EI - Left EI	-0.28	10.53	1.67	-3.65	3.09	-0.17	39.00	0.87
Right LI - Left LI	7.50	138.29	21.87	-36.73	51.72	0.34	39.00	0.73

EL = Ear Length, EW = Ear Width, LL = Lobular Length, LW = Lobular Width, EI = Ear Index, LI = Lobular Index, S.E.M = Standard Error of Mean, C.I = Confidence of Interval, df = degree of freedom

**Table 6: Paired T-test comparing the measured variables in on the Both sides (Right and Left) in Females from Bayelsa.**

Parameters	Paired Differences					Paired T-test		
	Mean	S.D	S.E.M	95% C.I of the Difference		t-value	df	P-value
				Lower	Upper			
Right EL - Left EL	1.04	5.72	0.90	-0.79	2.87	1.15	39	0.26
Right EW - Left EW	0.72	2.91	0.46	-0.21	1.65	1.56	39	0.13
Right LL - Left LL	0.20	1.86	0.29	-0.39	0.80	0.69	39	0.50
Right LW - Left LW	-0.87	2.06	0.33	-1.53	-0.22	-2.68	39	<b>0.01*</b>
Right EI - Left EI	0.36	7.71	1.22	-2.10	2.83	0.30	39	0.77
Right LI - Left LI	-6.33	15.01	2.37	-11.13	-1.53	-2.67	39	<b>0.01*</b>

EL = Ear Length, EW = Ear Width, LL = Lobular Length, LW = Lobular Width, EI = Ear Index, LI = Lobular Index, S.E.M = Standard Error of Mean, C.I = Confidence of Interval, df = degree of freedom

**Table 7: Paired T-test comparing the measured variables in the both sides (Right and Left) in females from Rivers State.**

Parameters	Paired Differences					Paired T-test		
	Mean	S.D	S.E.M.D	95% C.I of the Difference		t-value	df	P-value
				Lower	Upper			
Right EL - Left EL	0.16	4.37	0.51	-0.86	1.17	0.31	73	0.76
Right EW - Left EW	-0.25	6.54	0.76	-1.76	1.27	-0.32	73	0.75
Right LL - Left LL	-0.89	2.06	0.24	-1.36	-0.41	-3.71	73	<b>0.00*</b>
Right LW - Left LW	-1.32	3.49	0.41	-2.13	-0.51	-3.25	73	<b>0.00*</b>
Right EI - Left EI	-0.71	12.05	1.40	-3.50	2.08	-0.51	73	0.61
Right LI - Left LI	54.33	16.52	1.92	50.50	58.15	28.30	73	<b>0.00*</b>

EL = Ear Length, EW = Ear Width, LL = Lobular Length, LW = Lobular Width, EI = Ear Index, LI = Lobular Index, S.E.M = Standard Error of Mean, C.I = Confidence of Interval, df = degree of freedom

**Table 8: Paired T-test comparing the measured variables in the both sides (Right and Left) in Males from Rivers State.**

Parameters	Paired Differences					Paired T-test		
	Mean	S.D	S.E.M.D	95% C.I of the Difference		t-value	df	P-value
				Lower	Upper			
Right EL - Left EL	0.87	5.88	0.68	-0.49	2.23	1.27	73	0.21
Right EW - Left EW	0.18	4.85	0.56	-0.94	1.30	0.32	73	0.75
Right LL - Left LL	-0.33	2.23	0.26	-0.85	0.19	-1.27	73	0.21
Right LW - Left LW	-1.40	2.93	0.34	-2.08	-0.72	-4.10	73	<b>0.00*</b>
Right EI - Left EI	-1.02	7.86	0.91	-2.84	0.80	-1.12	73	0.27
Right LI - Left LI	52.10	14.09	1.64	48.83	55.36	31.80	73	<b>0.00*</b>

EL = Ear Length, EW = Ear Width, LL = Lobular Length, LW = Lobular Width, EI = Ear Index, LI = Lobular Index, S.E.M = Standard Error of Mean, C.I = Confidence of Interval, df = degree of freedom

**Table 9: T-test Comparing the Measured variables in Males from both Ethnic group (Bayelsa and Rivers).**

Parameters	Mean Difference				t-test for Equality of Means		
	M.D	S.E.M.D	95% C.I of the Difference		t-value	Df	P-value
			Lower	Upper			
Right Ear Length	-1.03	0.76	-2.53	0.48	-1.35	112.00	0.18
Right Ear Width	-0.94	0.99	-2.90	1.03	-0.94	112.00	0.35
Right Lobular Length	0.57	0.30	-0.03	1.17	1.88	112.00	0.06
Right Lobular Width	2.66	2.23	-1.76	7.09	1.19	112.00	0.24
Right Ear Index	-0.75	1.80	-4.31	2.81	-0.42	112.00	0.68
Right Lobular Index	16.45	21.79	-27.61	60.51	0.75	39.49	0.45
Left Ear Length	-1.36	1.01	-3.36	0.63	-1.35	112.00	0.18
Left Ear Width	-1.64	0.55	-2.72	-0.56	-3.00	112.00	<b>0.00*</b>
Left Lobular Length	-1.25	0.32	-1.88	-0.61	-3.89	112.00	<b>0.00*</b>
Left Lobular Width	-0.24	0.51	-1.25	0.77	-0.47	112.00	0.64
Left Ear Index	-1.18	1.47	-4.09	1.73	-0.80	112.00	0.42
Left Lobular Index	63.28	2.31	58.70	67.86	27.38	112.00	<b>0.00*</b>

*M.D* = Mean Difference, *S.E.M.D* = Standard Error of Mean Difference, *C.I* = Confidence Interval, \* = Significant

**Table 10: T-test comparing the measured variables in Females from both Ethnic group (Bayelsa and Rivers).**

Parameters	Mean Difference				t-test for Equality of Means		
	MD	S.E.M.D	95% C.I of the Difference		t-value	Df	P-value
			Lower	Upper			
Right Ear Length	1.26	0.96	-0.65	3.17	1.30	112.00	0.19
Right Ear Width	0.05	0.55	-1.03	1.13	0.08	112.00	0.93
Right Lobular Length	-0.05	0.35	-0.75	0.65	-0.15	112.00	0.88
Right Lobular Width	0.42	0.41	-0.41	1.24	1.00	112.00	0.32
Right Ear Index	-0.91	1.22	-3.32	1.50	-0.75	112.00	0.46
Right Lobular Index	2.89	2.76	-2.57	8.36	1.05	112.00	0.30
Left Ear Length	1.09	0.93	-0.75	2.93	1.17	112.00	0.24
Left Ear Width	-0.49	0.73	-1.94	0.96	-0.67	112.00	0.51
Left Lobular Length	-0.58	0.29	-1.16	-0.01	-2.01	112.00	0.05
Left Lobular Width	-0.10	0.45	-0.99	0.78	-0.23	112.00	0.81
Left Ear Index	-2.29	1.27	-4.81	0.22	-1.81	112.00	0.07
Left Lobular Index	61.32	2.48	56.32	66.33	24.72	42.48	<b>0.00*</b>

*M.D* = Mean Difference, *S.E.M.D* = Standard Error of Mean Difference, *C.I* = Confidence Interval, \* = Significant

## DISCUSSION

The external ear as an important component of the human facial complex, defines the face and conveys information about the age and sex of an individual.<sup>[2]</sup> Hence, there is no standard ear morphology and variations across ethnic groups.<sup>[10]</sup> From our study, the mean ear height was significantly higher in Bayelsa females **than in male** subjects at  $p < 0.05$  this contradicts some findings of.<sup>[7,11]</sup> Though the females had a higher lobular width which corresponds to the findings.<sup>[7]</sup> Gender variations in ear parameter was noted in the study with the female subjects having a higher right ear length and right lobular length compared to the male subjects which was statistically significant at  $p < 0.05$  for the Bayelsa ethnic group.

Sexual dimorphism was observed in ear width and lobular length of Rivers subjects with a significant difference at  $p < 0.05$  which is similar with the findings of<sup>[12]</sup>, this may be due to gender and age variance.<sup>[13]</sup> The ear width was found to be higher on the right ear of both sexes in both ethnic group but with no significant

difference and this corresponds to the findings of<sup>[6,9,14]</sup> except for the ear width of Rivers subjects that was higher on the left ear for males, this agrees with the findings according to.<sup>[15]</sup> The left (ear width, lobular length and lobular index) of male subjects for both ethnic groups showed significant difference at  $p < 0.05$  respectively. There was significant difference at  $p < 0.05$  for the left lobular index of female subjects. Thus, with regards to sex difference, the Right Lobular length (RLL) was significantly higher in males than in females while the Left Ear Width and Left Lobular length (LLL) were significantly higher in males than in females. No significant difference exists between ear index and lobular index although the right lobular indices was found to be higher than the left ear indices for all the subjects, but this does not agree with the study, where the left ear indices was higher than the right.<sup>[9]</sup> Difference in mean value was observed between the measured parameters in the present study and those of other authors that was reviewed in this study and this variation could be as a result of factors such as geographical location, genetic variables, individual constitution, age and experimental error (human).<sup>[8,16,17]</sup>

**CONCLUSION**

Knowledge of the external ear dimensions is important in the diagnosis of congenital anomalies, acquired deformities as well as in aesthetics. Thus, this study provides the mean values of different morphometric variables of left and right ears of Ijaws in Rivers and Bayelsa states, which could also be useful in determining ear variations and help plastic surgeons in the region.

**COMPETING INTERESTS**

Authors declare that no competing interests exist.

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