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MORPHOMETRIC EVALUATION OF THE EXTERNAL EAR IN RELATION TO ATTACHMENT PATTERN: A STUDY OF ADULT NIGERIANS RESIDENT IN THE SOUTHERN REGION

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ABSTRACT
There are two configurations of earlobe in humans; *attached and unattached* earlobe. This study was done to evaluate the morphology of the external ear in relation to attachment pattern and to determine the association between sex and morphology. A total of 450 subjects within the age of 18-45 resident the south-southern region of Nigeria was randomly selected for the study. Parameters measured from subjects who gave their consent include: Total auricular height (TAH), Total auricular width (TAW), Depth of inter-tragal notch (DIN), Auricular Projection (AP), Lobular width (LW), Lobular height (LH), Conchal width (CW), Conchal length (CL), Tragus to outer canthus angle (TCA) for both auricle with attached and unattached earlobe. The mean values of the measured parameters for both sexes was not significant. However, AP, DIN, TCA for males and females with attached earlobe was significant. All measured parameter had higher mean values for males compared to females except LH that was higher in females. Unattached earlobe was predominant in the study especially in females compared to males. Auricle with unattached earlobes are positioned closer to the outer canthus at tragal level than those with attached earlobes. It has therefore established that attachment pattern influences dimensions. A higher proportion of earlobes were unattached compared to the attached. Attachment pattern has no significant effect on the onset of loss of elasticity. Both types of earlobe are only affected either by nature or cultural practices. These findings will be useful in reconstructive surgery, forensic investigations and acoustic products design.

KEYWORDS: Attached, Unattached, Earlobes, Auricle.

1. INTRODUCTION
Anthropometry have always been centered on the evaluation of human body parts.
In humans, the external ear is one of the five primary features of the face particularly influential in determining facial appearance. [1] Its dimensions depend on a number of factors such shape, sex, ethnic group as well as orientation. Structurally, the human ear is divided into three parts; external, middle and internal parts. [1] The Pinna and External acoustic meatus form the external ear. [2] The external ear is best described as a flap-like structure characterized by exclusive as well as unique elevations and depressions. Such uniqueness is found useful in individual identification.

According to Ordu *et al* [3], earlobe in humans follows Mendelian inheritance pattern. It is either attached (*fused to the side of the head*) or *unattached (free)*. The free earlobe is the dominant expression of the trait while, the *attached* is recessive. The earlobe lacks firmness and elasticity found in the upper 2/3 of the auricle. Increase in linear dimensions of the earlobe, could result from loss of elasticity, natural gravitational pull usually by jewelries especially in females. Lobular dimensions such as lobular height, width and inter-tragal notch depth could vary as a result of the attachment pattern of the earlobe. A number of studies have been carried out on the prevalence of attached and unattached earlobe among various ethnic groups in Nigeria [3], [4], [5]. However, limited data exist on the relationship between the ear attachment pattern and morphometric differences. This study therefore seeks to evaluate possible morphometric differences that may exist as a result of earlobe attachment pattern and to provide ethnic specific data in external ear dimensions.

Proper understanding of normal anthropometric dimensions of the earlobe with regards to sex and ethnicity is necessary in reconstructive surgery and forensic investigations as well as in the design of ear prosthetics (Ekanem *et al* [4]; *Akpa et al* [5]; Sforza *et al*

[6]; Purkait and Singh [1]; Bozkir *et al* [7]; Ferrario *et al* [8]; Asai *et al* [9]; Alexander and Stott [10]).

2. MATERIALS AND METHODS

It was a cross-sectional study. Subjects were selected using simple random sampling technique. About 450 male and female subjects (18 to 45 years) were involved in the study. Sample size was determined using Cochran (1963). Subjects were selected from tertiary institutions and medical centres from all states (Akwa Ibom, Bayelsa, Delta, Edo, Rivers and Cross River) of the South-South region. Ethical approval was obtained from the University of Port Harcourt Ethics Committee with the following reference number; UPH/CEREMAD/REC/04.

Subjects who are indigenes of the selected states by paternal and maternal relationship (traceable up to the second generation) were involved in the study. While those with known ear deformity or those who have previously had surgery or trauma to the external ear were excluded from the study.

2.1 Procedure for data collection

Subjects who met the inclusion criteria were verbally informed of the study and those who gave their consent were involved in the study.

Subjects were meant to sit down comfortably with the head in a Frankfort horizontal plane using a back chair. External ear dimensions [Total auricular height (TAH), Total auricular width (TAW), Depth of inter tragal notch (DIN), Auricular Projection (AP), Lobular width (LW), Lobular height (LH), Conchal width (CW), Conchal length (CL), Tragus to outer canthus angle (TCA)] were measured using a sliding digital Vernier caliper (Raider Professional Digital Caliper with a 0.01 mm precision), while an angle protractor was used to measure TCA. Measurements were taken following landmarks and methodology as designed by De Carlo *et al.* (1998) [11], Ekanem *et al.* (2010) [5] and Eboh (2013). [12]

The TAH (Figure A) was measured as the distance from the most superior point of the helix (A) to the most inferior point of the earlobe (B). TAW (Figure A) was measured as the Distance from the tragus (C) to helix (D). LW (Figure C) as the transverse or horizontal width of the lobule at the midpoint of lobular height (O – P). LH (Figure C) as the distance from the inferior end (N) of the lobule to the base of tragal notch (M).

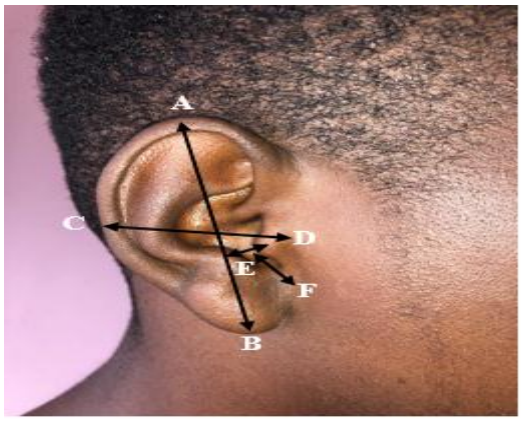

Fig. A: The measurements for total auricular height (TAH) A-B, total auricular width (TAW) C-D, and depth of inter-tragal notch (DIN) E-F.

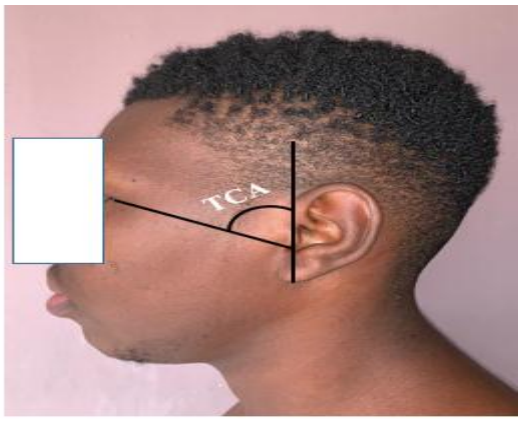

Fig. B: The measurement for Tragus to outer canthus angle (TCA).

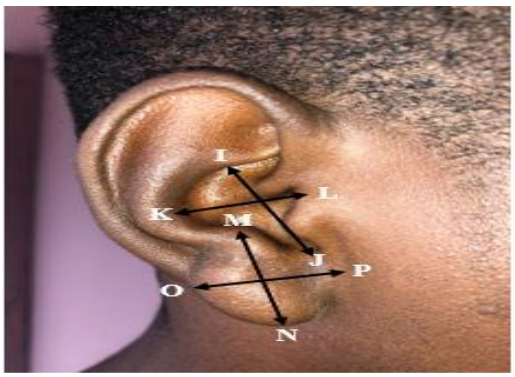

Fig. C: The measurement for conchal height (CH) I-J, conchal width (CW) K-L, lobular height (LH) M-N and lobular width (LW) O-P.

Fig. D: The measurement for auricular projection (AP)G-H.

2.2 Data analysis

Data was analyzed using Statistical Package for the Social Sciences (SPSS IBM® version 25, Armonk, New York) and Minitab V17 (Minitab® Inc. State College, Pennsylvania) statistical software. Confidence interval was set at 95% and $p < 0.05$ was considered significant. Mean values were presented in descriptive statistics (Mean±SD; Minimum and Maximum). Side and sex differences were evaluated using paired and independent sample t-test respectively, while association between sex and earlobe attachment pattern was determined using chi-square (X^2).

3. RESULTS AND DISCUSSION

Table 3.1: Distribution of earlobe type among the subjects.

Sex	Earlobe type		Chi-square test of association		
	Attached	Detached	df	X^2	*P*-value
Male	82 (51.3)	121 (49.8)	1	0.08	0.84
Female	78 (48.8)	122 (50.2)			
Total	**160 (100)**	**243 (100)**			

Table 3.2: Descriptive statistics of the measured parameters according to earlobe attachment pattern in male Subjects.

Auricular parameters	Earlobe type	N	Mean	SD	Min	Max	T-test		
							df	*t*-value	*p*-value
Right AP	Attached	82	19.84	3.12	10.05	30.06	201.00	0.36	0.72
	Unattached	121	19.69	2.76	10.07	30.09			
Left AP	Attached	82	19.85	3.09	12.00	30.06	201.00	0.55	0.59
	Unattached	121	19.63	2.73	10.09	30.08			
Right TAW	Attached	82	30.05	5.14	20.05	53.05	201.00	0.50	0.61
	Unattached	121	29.72	4.18	22.01	43.04			
Left TAW	Attached	82	29.60	6.17	10.07	53.09	201.00	-0.20	0.84
	Unattached	121	29.75	4.32	21.09	44.03			
Right TAL	Attached	82	57.63	5.33	29.02	69.07	201.00	-0.28	0.78
	Unattached	121	57.83	4.45	38.04	70.01			
Left TAL	Attached	82	57.73	5.33	29.07	69.05	201.00	-0.22	0.83
	Unattached	121	57.88	4.42	38.05	69.09			
Right LW	Attached	82	20.07	3.45	10.07	28.04	201.00	-1.12	0.26
	Unattached	121	20.65	3.64	11.09	33.02			
Left LW	Attached	82	20.02	3.21	13.09	28.02	201.00	-1.21	0.23
	Unattached	121	20.62	3.63	12.01	33.04			
Right LH	Attached	82	16.61	2.77	11.06	23.01	201.00	-0.59	0.56
	Unattached	121	16.87	3.22	10.03	25.02			
Left LH	Attached	82	16.54	2.72	11.07	23.06	201.00	-0.85	0.40
	Unattached	121	16.90	3.13	10.02	25.00			
Right CW	Attached	82	18.91	3.45	11.02	27.03	201.00	-0.92	0.36
	Unattached	121	19.40	3.97	6.09	30.02			
Left CW	Attached	82	18.90	3.43	11.01	27.04	201.00	-0.89	0.38
	Unattached	121	19.38	3.91	6.06	30.01			
Right CH	Attached	82	22.64	6.74	7.07	37.02	201.00	-0.73	0.47
	Unattached	121	23.31	6.27	7.02	44.06			
Left CH	Attached	82	22.71	6.74	7.04	36.08	201.00	-0.35	0.73
	Unattached	121	23.03	5.92	7.07	35.04			
Right DIN	Attached	82	7.86	1.74	3.06	11.03	201.00	0.04	0.97
	Unattached	121	7.85	1.65	4.08	12.07			
Left DIN	Attached	82	7.89	1.77	4.02	11.07	201.00	0.11	0.91
	Unattached	121	7.86	1.65	4.04	12.02			
Right TCA	Attached	82	83.65	5.76	62.00	97.00	200.36	1.08	0.28
	Unattached	121	82.60	8.05	60.00	95.00			
Left TCA	Attached	82	83.66	5.73	62.00	97.00	200.17	1.23	0.22
	Unattached	121	82.48	7.94	60.00	96.00			

AP = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.3: Descriptive statistics of the measured parameters according to earlobe attachment pattern in female Subjects.

Auricular parameters	Earlobe type	N	Mean	SD	Min	Max	T-test		
							df	*t*-value	*p*-value
Right AP	Attached	78	18.89	2.68	13.04	26.00	198.00	1.35	0.18
	Unattached	122	18.36	2.69	11.07	27.06			
Left AP	Attached	78	18.93	2.67	13.02	25.08	198.00	1.50	0.14
	Unattached	122	18.33	2.83	11.03	27.04			
Right TAW	Attached	78	29.64	3.48	23.05	38.04	191.07	1.47	0.14
	Unattached	122	28.80	4.51	13.02	40.02			
Left TAW	Attached	78	29.60	3.50	23.02	38.08	192.91	1.43	0.15
	Unattached	122	28.77	4.67	12.09	40.05			
Right TAL	Attached	78	56.74	4.26	45.07	68.05	198.00	-0.71	0.48
	Unattached	122	57.23	5.05	36.00	86.02			
Left TAL	Attached	78	56.77	4.15	45.02	68.07	198.00	-0.65	0.52
	Unattached	122	57.21	5.07	36.03	86.02			
Right LW	Attached	78	20.83	3.17	13.07	30.06	198.00	0.33	0.74
	Unattached	122	20.68	3.26	10.09	30.05			
Left LW	Attached	78	20.81	3.18	12.09	30.07	198.00	0.42	0.67
	Unattached	122	20.61	3.33	11.02	30.09			
Right LH	Attached	78	16.89	2.85	10.06	24.01	198.00	-0.28	0.78
	Unattached	122	17.02	3.23	8.09	30.04			
Left LH	Attached	78	16.97	2.87	10.06	24.06	198.00	0.08	0.94
	Unattached	122	16.94	3.18	10.01	30.06			
Right CW	Attached	78	19.04	4.05	7.07	27.05	198.00	-0.08	0.94
	Unattached	122	19.09	4.54	6.08	30.07			
Left CW	Attached	78	19.08	4.08	7.09	27.03	198.00	-0.02	0.98
	Unattached	122	19.10	4.50	7.03	30.05			
Right CH	Attached	78	23.36	6.00	7.02	30.09	198.00	0.61	0.54
	Unattached	122	22.78	6.93	7.09	35.08			
Left CH	Attached	78	23.27	5.98	7.06	31.03	198.00	0.64	0.52
	Unattached	122	22.65	7.01	8.02	35.09			
Right DIN	Attached	78	7.20	1.78	4.08	11.03	198.00	-1.86	0.07
	Unattached	122	7.69	1.85	2.09	12.05			
Left DIN	Attached	78	7.18	1.68	5.02	10.09	198.00	-1.93	0.06
	Unattached	122	7.69	1.88	2.07	12.02			
Right TCA	Attached	78	80.24	8.40	60.00	97.00	198.00	-0.39	0.69
	Unattached	122	80.76	9.49	20.00	96.00			
Left TCA	Attached	78	80.42	8.59	60.00	98.00	198.00	-0.64	0.52
	Unattached	122	81.17	7.75	60.00	95.00			

AP = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.4: T-test comparing male and female subjects with attached earlobe.

Auricular parameters (mm)	Mean Difference				t-test for Equality of Means		
	MD	SEMD	95% C.I of the Diff		*t*-value	df	*p*-value
			Lower	Upper			
Age (years)	2.50	1.04	0.44	4.56	2.40	155.63	**0.02***
Right AP	0.96	0.46	0.05	1.87	2.08	158.00	**0.04***
Right TAW	0.41	0.70	-0.96	1.79	0.59	158.00	0.56
Right TAL	0.89	0.77	-0.62	2.40	1.16	158.00	0.25
Right LW	-0.76	0.52	-1.79	0.28	-1.44	158.00	0.15
Right LH	-0.28	0.44	-1.16	0.60	-0.63	158.00	0.53

Right CW	-0.13	0.59	-1.30	1.04	-0.22	158.00	0.82
Right CH	-0.72	1.01	-2.72	1.28	-0.71	158.00	0.48
Right DIN	0.66	0.28	0.11	1.21	2.36	158.00	**0.02***
Right TCA	3.40	1.14	1.14	5.67	2.97	135.57	**0.00***
Left AP	0.92	0.46	0.02	1.83	2.02	158.00	**0.04***
Left TAW	0.00	0.79	-1.56	1.56	0.00	129.56	1.00
Left TAL	0.97	0.76	-0.53	2.47	1.28	158.00	0.20
Left LW	-0.79	0.51	-1.79	0.21	-1.57	158.00	0.12
Left LH	-0.43	0.44	-1.30	0.44	-0.97	158.00	0.33
Left CW	-0.18	0.60	-1.36	0.99	-0.30	158.00	0.76
Left CH	-0.56	1.01	-2.55	1.44	-0.55	158.00	0.58
Left DIN	0.70	0.27	0.16	1.24	2.57	158.00	**0.01***
Left TCA	3.24	1.16	0.94	5.53	2.79	133.21	**0.01***

***** = Significant, **MD** = Mean difference, **SEM** = Standard error of mean difference, **C.I** = Confidence Interval, **diff** = difference, **AP** = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.5: T-test comparing male and female subjects with unattached earlobe.

Auricular parameters (mm)	Mean Difference				t-test for Equality of Means		
	MD	SEMD	95% C.I of the Diff		df	*t*-value	*p*-value
			Lower	Upper			
Age (years)	1.62	0.86	-0.07	3.31	241.00	1.89	0.06
Right AP	1.33	0.35	0.65	2.02	241.00	3.82	**0.00***
Right TAW	0.92	0.56	-0.18	2.02	241.00	1.64	0.10
Right TAL	0.59	0.61	-0.61	1.80	241.00	0.97	0.33
Right LW	-0.03	0.44	-0.90	0.84	241.00	-0.07	0.95
Right LH	-0.15	0.41	-0.96	0.67	241.00	-0.36	0.72
Right CW	0.31	0.55	-0.76	1.39	241.00	0.57	0.57
Right CH	0.53	0.85	-1.14	2.21	241.00	0.63	0.53
Right DIN	0.16	0.23	-0.29	0.60	241.00	0.69	0.49
Right TCA	1.84	1.13	-0.38	4.06	241.00	1.63	0.10
Left AP	1.30	0.36	0.60	2.00	241.00	3.65	**0.00***
Left TAW	0.98	0.58	-0.16	2.12	241.00	1.70	0.09
Left TAL	0.67	0.61	-0.53	1.88	241.00	1.11	0.27
Left LW	0.01	0.45	-0.87	0.89	241.00	0.02	0.99
Left LH	-0.04	0.41	-0.83	0.76	241.00	-0.09	0.93
Left CW	0.28	0.54	-0.79	1.35	241.00	0.52	0.61
Left CH	0.37	0.83	-1.26	2.01	235.05	0.45	0.65
Left DIN	0.17	0.23	-0.28	0.62	241.00	0.75	0.46
Left TCA	1.31	1.01	-0.68	3.29	241.00	1.30	0.20

Table 3.6: Paired t-test comparing male subjects with attached earlobe.

Auricular parameters (mm)	Paired Differences					Paired t-test		
	MD	SD	SE	95% C.I of the Diff		df	*t*-value	*p*-value
				Lower	Upper			
Right AP - Left AP	-0.01	0.71	0.08	-0.17	0.15	81	-0.11	0.92
Right TAW - Left TAW	0.45	3.59	0.40	-0.34	1.24	81	1.13	0.26
Right TAL - Left TAL	-0.10	1.30	0.14	-0.39	0.18	81	-0.73	0.47
Right LW - Left LW	0.05	1.19	0.13	-0.21	0.31	81	0.40	0.69
Right LH - Left LH	0.07	0.63	0.07	-0.07	0.21	81	0.97	0.33
Right CW - Left CW	0.00	0.54	0.06	-0.12	0.12	81	0.05	0.96
Right CH - Left CH	-0.08	0.48	0.05	-0.18	0.03	81	-1.45	0.15
Right DIN - Left DIN	-0.03	0.42	0.05	-0.12	0.06	81	-0.61	0.55
Right TCA - Left TCA	-0.01	0.76	0.08	-0.18	0.16	81	-0.14	0.89

***** = Significant, **MD** = Mean difference, **SEM** = Standard error of mean difference, **C.I** = Confidence Interval, **diff** = difference, **AP** = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular

width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.7: Paired t-test comparing male subjects with unattached earlobe.

Auricular parameters (mm)	Paired Differences					Paired t-test		
	MD	SD	SE	95% C.I of the Diff		df	*t*-value	*p*-value
				Lower	Upper			
Right AP - Left AP	0.07	0.65	0.06	-0.05	0.18	120.00	1.11	0.27
Right TAW - Left TAW	-0.03	0.61	0.06	-0.14	0.08	120.00	-0.54	0.59
Right TAL - Left TAL	-0.06	0.62	0.06	-0.17	0.05	120.00	-1.05	0.29
Right LW - Left LW	0.02	0.50	0.05	-0.06	0.11	120.00	0.55	0.58
Right LH - Left LH	-0.04	0.45	0.04	-0.12	0.05	120.00	-0.85	0.40
Right CW - Left CW	0.03	0.50	0.05	-0.06	0.12	120.00	0.60	0.55
Right CH - Left CH	0.28	1.99	0.18	-0.07	0.64	120.00	1.57	0.12
Right DIN - Left DIN	-0.01	0.39	0.04	-0.08	0.06	120.00	-0.35	0.73
Right TCA - Left TCA	0.12	0.75	0.07	-0.01	0.26	120.00	1.82	0.07

***** = Significant, **MD** = Mean difference, **SEM** = Standard error of mean difference, **C.I** = Confidence Interval, **diff** = difference, **AP** = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.8: Paired t-test comparing female subjects with attached earlobe.

Auricular parameters (mm)	Paired Differences					Paired t-test		
	MD	SD	SE	95% C.I of the Diff		df	*t*-value	*p*-value
				Lower	Upper			
Right AP - Left AP	-0.04	0.62	0.07	-0.18	0.10	77	-0.59	0.56
Right TAW - Left TAW	0.04	0.51	0.06	-0.08	0.15	77	0.68	0.50
Right TAL - Left TAL	-0.02	0.55	0.06	-0.15	0.10	77	-0.37	0.71
Right LW - Left LW	0.02	0.66	0.07	-0.13	0.16	77	0.20	0.84
Right LH - Left LH	-0.08	0.52	0.06	-0.20	0.04	77	-1.39	0.17
Right CW - Left CW	-0.05	0.56	0.06	-0.17	0.08	77	-0.73	0.46
Right CH - Left CH	0.09	0.72	0.08	-0.07	0.25	77	1.08	0.29
Right DIN - Left DIN	0.02	0.47	0.05	-0.09	0.12	77	0.30	0.76
Right TCA - Left TCA	-0.18	0.92	0.10	-0.39	0.03	77	-1.72	0.09

***** = Significant, **MD** = Mean difference, **SEM** = Standard error of mean difference, **C.I** = Confidence Interval, **diff** = difference, **AP** = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Table 3.9: Paired t-test comparing female subjects with unattached earlobe.

Auricular parameters (mm)	Paired Differences					Paired t-test		
	MD	SD	SE	95% C.I of the Diff		df	*t*-value	*p*-value
				Lower	Upper			
Right AP – Left AP	0.03	0.73	0.07	-0.10	0.16	121	0.49	0.63
Right TAW – Left TAW	0.03	0.98	0.09	-0.14	0.21	121	0.37	0.71
Right TAL – Left TAL	0.02	0.60	0.05	-0.08	0.13	121	0.43	0.67
Right LW – Left LW	0.06	0.83	0.07	-0.09	0.21	121	0.82	0.41
Right LH – Left LH	0.08	0.52	0.05	-0.01	0.17	121	1.66	0.10
Right CW – Left CW	-0.01	0.62	0.06	-0.12	0.10	121	-0.13	0.90
Right CH – Left CH	0.12	0.52	0.05	0.03	0.22	121	2.59	**0.01***
Right DIN - Left DIN	0.00	0.37	0.03	-0.06	0.07	121	0.03	0.97
Right TCA - Left TCA	-0.41	4.55	0.41	-1.23	0.41	121	-0.99	0.32

***** = Significant, **MD** = Mean difference, **SEM** = Standard error of mean difference, **C.I** = Confidence Interval, **diff** = difference, **AP** = Auricular projection, **TAW** = Total auricular width, **TAL** = Total auricular length, **LW** = Lobular width, **LH** = Lobular height, **CW** = Conchal width, **CH** = Conchal height, **DIN** = Depth of inter tragal notch, **TCA** = Tragus to outer canthus angle

Results were presented in Tables 3.1-3.9. The distribution of the subjects according to earlobe attachment pattern and chi-square analysis was presented in Table 3.1. The descriptive statistics of the measured parameters were presented in Table 3.2 and 3.3. The mean values for the measured parameters in male subjects were presented in Table 3.2, while that of the females were presented in Table 3.3. Significant association was not observed between attached and unattached earlobe in male and female subjects at $p <$ 005. Significant difference was also not observed in auricular dimensions, for male and female subjects with attached earlobe, except for Right AP (t = 2.08; p = 0.04), Right DIN (t = 2.36; p = 0.02), Right TCA (t = 2.97; p = 0.00), Left AP (t = 2.02; p = 0.04), Left DIN (t = 2.57; p = 0.01) and Left TCA (t = 2.79; p = 0.01). For subjects with unattached earlobe, significant differences were not observed except in Right AP (t = 1.89; p = 0.00) and Left AP (t = 3.65; p = 0.00). Significant difference was not observed in the left and right auricular dimensions when compared among males with attached earlobe, males with unattached earlobe, females with attached earlobe. However, the Right and Left CH was statistically significant (t = 2.59; p = 0.01) in females with unattached earlobe.

The present study examined the dimensions of TAH, TAW, DIN, AP, LW, LH, CW, CL and TCA of the right and left auricle (ear) in male and female subjects from south-south Nigeria.

The study evaluated two types of auricle (attached and detached) in males and females and found no sex-associated difference at $p < 0.05$. There was more unattached earlobe compared to the attached. The female subjects had more unattached earlobe when compared to the male subjects. Similar findings were made by Shang *et al.* (2012) and Anibor *et al.* (2014) [13], while Eboh (2017) [13] and Nwaopara *et al.* (2008) [14] reported that unattached earlobe was more common among females in some ethnic groups. Williams *et al.* (2008) [15] also reported same for Lagos population. Similarly, Ebeye *et al.* (2014) [16] also came to the same conclusion that though unattached earlobe was more prevalent there was no significant difference between gender and earlobe attachment among Esan indigenes of Edo State. On the contrary, Sadia *et al.* (2015) [17] and Verma *et al.* (2016) [18] reported that attached earlobe was more prevalent in a Pakistani and Indian population respectively. Differences in earlobe distribution from one population to another could have possible genetic undertone as suggested by Nwaopara *et al.* (2008) [14] and Ordu *et al.* (2014) [3].

Male subjects with attached earlobe have higher mean values for the Right AP, Left AP, Right TAW, Right DIN, Left DIN, Right TCA and Left TCA. On the other hand, higher mean values were recorded for unattached earlobe in Left TAW, Right and Left TAL, Right and Left LW, Right and Left LH, Right and Left CW, Right and Left CH. Female subjects with attached earlobe have mean values for the Right and Left AP, Right and Left TAW, Right and Left LW, Left LH, Right and Left CH as well as Left TCA. Females with unattached earlobe had higher mean values for Right and Left TAL, Right LH, Right and Left CW, Right and Left DIN as well a Right TCA.

Data from previous studies with regards to morphometric differences in different earlobe attachment patterns is scarce, which has informed the current study. Majority of the ear parameters measured had higher mean values for the unattached ear, especially the TAL and LH and CW. This therefore suggests that the unattached ear experiences a gravitational pull which stretches the ear resulting to an increase in length. Significant difference was not observed in TAL among male and female subjects with attached or unattached earlobe suggesting that jewelries are light enough and does not really have any impact or add additional weight capable of stretching the ear, which results to an increase in length. This is not in agreement with Ito *et al.* (2001) [19], who were of the opinion that heavy adornment of the ear with jewelries is capable of increasing its length.

Sex based differences was observed for the attached ear in Right AP, Right DIN, Right TCA, Left AP, Left DIN and Left TCA. While for the unattached ear, significant difference was only observed in Right and Left AP.

Unattached earlobes were closer in line with the outer canthus at tragal level i.e. they were set higher than the attached earlobes, although the difference was not statistically significant at $p < 0.05$.

Symmetrical relationship between the right and the left ear was observed in male as well as female subjects with attached and unattached earlobe. Significant difference was not observed in the measured parameters for the right and left attached as well as right and left unattached ear in male and female subjects respectively.

4. CONCLUSION

The morphology of the auricle has peculiarities when it comes to its attachment pattern.

The current study has documented differences in the morphometry of the attached and unattached earlobe. Sexual dimorphism was observed in male and female subjects with attached, as well as male and female subjects with unattached earlobes.

The prevalence of morphogenetic traits like the earlobe as investigated in this study has suggested that unattached earlobe is the most common type in south-southern Nigeria. The earlobe, whether attached or unattached has no significant effect on the onset of loss of elasticity. Both types of earlobe could only be affected by nature, cultural practices or individual habits.

This study has provided data specific to south-southern Nigeria and has proven that the attachment pattern of the earlobe does not affect its morphology.

5. CONFLICT OF INTEREST

There was no conflict of interest among the authors.

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