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An Anthropometric Study of External Ear of Medical Students in India

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Abstract

Anthropometric refers to the measurements of living human body dimensions for the purpose of understanding human physical variation as it plays an important role in plastic surgery, prosthetics, so on for data collection. Many studies have defined human body parts and their proportion to each other morphometrically in human ear is the defining feature of the face and its structure shows the signs of age & sex. The human ear is divided in to external, middle and internal parts. Pinna & external acoustic meatus form the external ear. This study was carried out on 100 medical students age ranges from 17-26 years (44 females/56 males) studying in Ayaan institute of medical sciences, kanakamamidi, R.R. Dist. Telangana Subjects with evidence of congenital ear anomalies or previous ear surgeries excluded from the study. Following parameters of the external ear measured according to Mckinney et al. methodology. Anthropological measurement of external ear was found significantly different in male and females. Knowledge about the normal ear dimensions is important in the diagnosis of congenital malformations, syndromes and acquired deformities as well as planning of treatment & hearing instruments industry. This study provides the mean values of the different morphometric measurements of right & left ears in the medical students age ranging from 17-26 years in Indian region.

Keywords: External ear; Anthropometric measurements; Hearing instruments; Plastic surgery.

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Introduction

Anthropometric refers to the measurements of living human body dimensions for the purpose of understanding human physical variation as it plays an important role in plastic surgery, prosthetics, so on for data collection [1]. Many studies have defined human body parts and their proportion to each other morphometrically in human ear is the defining feature of the face and its structure shows the signs of age & sex. The human ear is divided in to external, middle and internal parts. Pinna & external acoustic meatus form the external ear. The lateral surface of the pinna is irregular concave, faces slightly forward and displays numerous eminences and depression [1]. The importance of anthropometric data was stressed by Abeysekera & Shahnavaz when they stated that a piece of equipment designed to fit 90% of the male united state population would fit about 90% of Germans, 80% of frenchmen, 65% of italians, 45% of japanese, 20% of thais and 10% of vietnamese [2]. Roebuck et al noted that anthropometric data vary considerably for individual within a family or a nation and between nation [3]. Since anthropometric data should be established for the user population as anthropometric data for India region is scant so, the aim of the present study is to provide the anthropometric data for the ear in Indian region.

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Materials and Methods

This study was carried out on 100 medical students age ranges from 17-26 years (44 females/56 males) studying in Ayaan institute of medical sciences, kanakamamidi, R.R. Dist. Telangana. Subjects with evidence of congenital ear anomalies or previous ear surgeries excluded from the study. Measurements of ear taken according to the landmarked points defines from Decarlo et al., [4] & Methodology was from Mckinney et al., [5] and Brucker et al., [6] The parameters measured when the head is in frankfort horizontal plane.

1. Total Ear Height (T.E.H)- Distance between the most inferior projection of the ear lobule to the most superior projection of the Helix (L-H).
2. Total Ear Width (T.E.W) – Distance between the most anterior and posterior points of the ear (A-P).
3. Lobular Height (L.H) – Distance between the most inferior end of lobule to the base of tragal notch (L-T).
4. Lobular width (L.W)- Transverse or horizontal width of the ear lobule (C-D).

Additional indices are also measured to defining the proportions of the ear such as:

Ear Index = Total Ear Width (T.E.W)/ Total Ear Height (T.E.H) X100

Lobular index =Lobular width (L.W)/Lobular height (L.H) X100

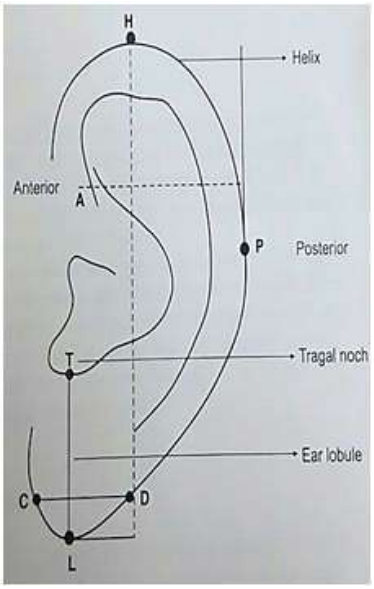

Fig 1: Reference points used for anthropometric measurements of ear. L-H: Total Ear Height; A-P: Total Ear Width; L-T: Lobular Height; C-D: Lobular Width.

All the parameters measured by a single investigator using standard digital Vernier caliper and the numerical data were analyzed using (S.P.S.S) version 16th, comparisons of measurement according to gender and various age groups were performed with independent sample t-test & paired sample t-test.

Results

The measurements and comparison of results for the right & left ears according to age group subjects

Table 1: Different morphometric ear measurements in relation to age

Measurements	Age Group (n=100)		
	17-18 years (22) Mean ±SD	9-20 years (61) Mean ±SD	≥21 years (17) Mean ±SD
Right Ear TEH (cm)	6.12±1.35	6.12±0.91	5.75±1.53
TEW (cm)	2.99±0.67	3.05±0.49	2.79±0.79
LH (cm)	1.69±0.72	1.66±0.33	1.52±0.45
LW (cm)	1.76±0.48	1.80±0.36	1.72±0.51
Left Ear TEH (cm)	5.77±1.32	6.02±1.07	5.80±1.53
TEW (cm)	2.84±0.70	3.02±0.63	2.81±0.75
LH (cm)	1.65±0.58	1.63±0.32	1.51±0.43
LW (cm)	2.05±0.58	1.88±0.41	1.78±0.52

Table 2: Right and left ear measurements and comparison of the results.

Measurements	Males (56) Mean ±SD	p-value	Females (44) Mean ±SD	p-value	Combined (100) Mean ±SD	p-value
Ear Height Right	6.20±0.95	0.734	5.86±0.97	0.289	6.11±0.75	0.592
Left	6.06±1.12		5.88±0.95		6.04±0.85	

Ear width Right	3.07±0.52	0.099	2.89±0.49	0.592	3.02±0.42	0.498
Left	3.06±0.52		2.87±0.66		3.00±0.51	
Lobule Right height	1.68±0.48	0.051	1.63±0.32	0.342	1.67±0.38	0.032
Left	1.60±0.32		1.63±0.31		1.63±0.28	
Lobule Right height	1.79±0.35	0.562	1.78±0.40	0.317	1.81±0.33	0.323
Left	1.88±0.40		1.90±0.46		1.91±0.38	
Ear Index Right	48.66±7.49	0.132	48.41±8.59	0.385	48.97±6.63	0.817
Left	48.78±8.06		48.83±8.46		49.31±6.56	
Right	110.27±26.21	0.283	108.65±21.60	0.791	110.78±21.45	0.298
Lobule Index Left	115.84±29.74		114.69±26.28		116.71±25.64	

According to Table 2, TEH, TEW, LH measurements are more in right ear, whereas LW, EI, LI were more in left ear but the difference between the right and left sides statistically insignificant.

Table 3: Comparison of measurements according to gender (n=100)

Measurements	Male (56) Mean ±SD	Female (44) Mean ±SD	p-value
Right ear height	6.20±0.95	5.86±0.97	0.001
Right ear width	3.07±0.52	2.89±0.49	0.001
Right lobule height	1.68±0.48	1.63±0.32	0.789
Right lobule width	1.79±0.35	1.78±0.40	0.218
Right ear index	48.66±7.96	48.41±8.59	0.823
Right lobule index	110.27±26.21	108.65±21.60	0.326
Left ear height	6.06±1.12	5.88±0.95	0.000
Left ear width	3.06±0.52	2.87±0.66	0.005
Left lobule height	1.60±0.32	1.63±0.31	0.739
Left lobule width	1.88±0.40	1.90±0.46	0.635
Left ear index	48.78±8.06	48.83±8.46	0.132
Left lobule index	115.84±29.74	114.69±26.28	0.894

According to Table-3 Total ear height (THE), Total ear width (TEW) of both right & left ears are more in male than female and the difference between the sides were significant statistically P value (0.001).

who participated in the study are shown in Table 1. The mean of TEH, EW, LH, LW were found to be increasing with advancing age in both the sexes up to 20 years, afterwards the measurements are not increasing.

Discussion

The TEH is important in the evaluation of congenital anomalies (Down syndrome) [7,8]. The ear reaches its mature height at 13 years in males and at 12 years in females [9]. In a study on north American whites, it was observed that the total height of the left ear as 62.4 mm in men and 58.5 mm in women and that the same measurements was 70.1 mm in Japanese people [10].

In Bozkir et al., study, the height of the left ear was found to be 63.1 mm in men and 59.7 mm in women [11]. In the present study TEH of left ear in males is 6.06 cm and 5.88 cm in females, which is increasing with age and found to be significantly ($p<0.001$) higher in males. The studies of Barut and Aktunc et al., and so many previous workers study supporting our study the mean height of the ears on both sides was significantly higher in males than females [12].

According to Farkas IG et al. studies the mature width of the ear is achieved in males at 7 years and in females at 6 years [7]. In a study done by Balogh B et al., E.W to be 32.4 mm for the left ear and 33 mm for the right ear in men and to be 31.9 mm for the left ear and 32.4mm for the right ear in women [13].

However, Della croce et al., reported the E.W to be 30.5 mm. According to Bozkir et al., E.W to be 33.3 mm for the left ear and 33.1 mm for that right ear in 191 men, as compared with 31.3 mm for the left ear and 31.2 mm for the right ear of 150 young women [11], while coming to our study E.W in male for the right ear is 3.07 cm and left 3.06 cm. In females for the right ear 2.89 cm and left ear 2.87 cm respectively, previous studies support our study that E.W measurement are more in male than

in females on both sides with significant p-value (0.001). According to our study right L.H & right L.W are more in males than in females but left L.H & left L.W are more in females than in males with not significant statistically. While ear indices right E. I & L. I & left L. I are more in males than in females without significant p-value. But left E.I is more in females than males. When we compare our study with those of others we find that there is a difference in the values of ear measurements & these discrepancies could be a result of factors such as race, genetic variables, individual constitution, environments, age & human error. With regards to the sex difference showed the TEH & EW were significantly higher in men than females.

An acquired deformity that develops with aging may include elongation or ptosis of the ear. This condition has been attributed to the loss of elastic fibers and gravitational forces. Earrings are an additional weight on the ears, and they therefore affect ear lobe height.

Conclusion

Knowledge about the normal ear dimensions is important in the diagnosis of congenital malformations, syndromes and acquired deformities as well as planning of treatment & hearing instruments industry. This study provides the mean values of the different morphometric measurements of right & left ears in the medical students age ranging from 17-26 years in South Indian region.

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