

# Anthropometric study of adult human external ear

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## Abstract

**Aims and Objectives:** To study and compare the normal anthropometric measurements of external ear in males and females of 18-21yrs on either sides. **Material and Methods:** This study was carried out on 100 medical students of PIMS and R, Islampur, out of which 50 males and 50 females. Subjects with congenital ear anomalies and previous ear surgeries were excluded from the study. Digital vernier caliper was used to take the ear measurements. Parameters were total ear length, ear width. The data was analyzed by using SPSS version 16.0. **Observation and Results:** All the parameters were larger in males as compared to females and also significantly larger on right side than the left one which was statistically significant. **Conclusion:** Normal measurements of bilateral external ear of males and females obtained in the study may be helpful in plastic reconstructive surgeries in congenital ear anomalies by plastic surgeons and also for making hearing aids.

**Key Words:** Anthropometry, morphometry, vernier caliper, hearing aids.

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## INTRODUCTION

The human external ear composed of pinna, external acoustic meatus and external acoustic canal. The external ear which is also known as pinna is formed by three primary components; the helix-antihelix complex, the conchal complex, and the lobule<sup>1</sup>. The ear pinna is yellow elastic cartilage which gives it the characteristic shape. Ear lobule is simply fold of skin containing fibro fatty tissue. Ear pinna develops in 4<sup>th</sup> and 6<sup>th</sup> weeks of gestation<sup>2</sup>. According to many studies conducted on morphometry of external ear; the size, shape and the orientation of each external ear is unique as fingerprint but it can be generalised. Males have larger ears as

compared to females. In females ears increases with age from birth to 99 yrs of age but in case of males development of ears stop around 50-70 yrs of age<sup>3</sup>. The current study provides information of dimensions of total ear length and ear width of both sides in males and females of age group 18-21yrs. which is one of the parameter of morphometry of external ear. These ear dimensions may be helpful in constructive and periauricular surgeries of external ear, designing ear prosthesis.

## MATERIALS AND METHODS

Present study was carried out in department of Anatomy, on 100 students (50 males and 50 females) between 18-21 yrs of age. These all are students of I and II MBBS of Prakash Institute of Medical Sciences and Research Centre, Islampur, Sangli. Students with congenital deformity, tumour, trauma, or previous surgery to pinna were excluded. Informed oral consent was taken. Bilateral auricles were measured with the help of standard vernier caliper which can measure 0.1mm. Parameters measured were total ear length (TEL), ear width (EW), lobular height (LH), lobular width (LW). All the parameters were measured with subject in the sitting position with head in Frankfort horizontal plane. TEL was calculated by

measuring highest point of pinna (A) to the lowest point of pinna (B). EW was anterior and posterior points on pinna. The LH was measured from midpoint of the base of intertragic notch to the lowest point of lobule. LW was considered as the transverse distance of ear lobule passing through centre of length of lobule. Data was analyzed by

using SPSS version 16.0. Comparisons of the measurements according to sex were done by using an independent samples t test. Comparison of measurements of right and left ears were performed by using paired samples t-test.

## OBSERVATIONS AND RESULTS

Table 1:

Comparison of male right vs female right ear								
Variables	Ear length		Ear width		Lobular height		Lobular width	
	M	F	M	F	M	F	M	F
Mean	59.98	57.71	28.74	25.62	18.21	18.11	22.30	19.30
S.D.	3.51	2.96	2.16	2.46	2.72	2.32	2.70	1.88
t value	3.4959		6.72060		1.7360		4.3007	
p value	0.00834		0.00004		0.4257		0.0013	

Table 2:

Comparison of male left vs female left ear								
Variables	Ear length		Ear width		Lobular height		Lobular width	
	M	F	M	F	M	F	M	F
Mean	58.30	57.30	28.73	25.70	18.01	17.47	22.11	19.72
S.D.	3.81	3.04	2.32	2.40	2.71	2.22	2.49	2.31
t value	1.4584		6.5599		1.0771		4.95526	
p value	0.8543		0.00003		0.34458		0.00603	

Table 3:

Comparison of male right vs left ear								
Variables	Ear length		Ear width		Lobular height		Lobular width	
	R	L	R	L	R	L	R	L
Mean	59.98	58.30	28.74	28.73	18.02	18.01	22.30	2.11
S.D.	3.51	3.82	2.16	2.32	2.71	2.71	2.70	2.49
t value	2.28316		2.2476		1.2356		1.5525	
p value	0.05433		0.08095		0.27219		0.5792	

Table 4:

Comparison of female right vs left ear								
Variables	Ear length		Ear width		Lobular height		Lobular width	
	R	L	R	L	R	L	R	L
Mean	57.71	57.30	25.62	25.70	18.11	17.47	19.30	19.72
S.D.	2.96	3.04	2.46	2.40	2.32	2.22	1.88	2.31
t value	1.00681		1.00581		1.3984		1.00724	
p value	0.32445		0.15820		0.30793		0.15138	

**Results:** The measurements and comparison of results of all the individuals who participated in the study according to genders are tabulated in table no 1 and table no 2. The data shows significant differences mainly in total ear length and ear width of male and female right ear and left ear. The dimensions of the external ear of males and females which depicts higher values in males as compared to females. The Table no 3 and table no 4 shows comparison of male right and left ear, female right and left ear respectively which also shows differences in

dimensions of external ear with right sided higher values in both males and females.

## DISCUSSION

According to Ito I *et al* (2001), in case of male the external ear acquires its mature height at 13yrs and in females at the age of 12 yr<sup>4</sup>. The differences in the dimensions of external ear were determined by several authors, with higher values in males as compared to females<sup>5,6</sup>. Another study carried out on Turkish and Japanese populations done by Bozkir *et al* (2006)

observed that total ear length and width were longer in males of the Turkish population<sup>7</sup>. Ekanem *et al* (2010) stated that all the values of pinna are higher in males as compared to females<sup>6</sup>. Similar finding of sexual dimorphism are seen in the present study. Same was also observed by author Nidhi Sharma<sup>2</sup>. Pradhuman Verma *et al* (2016) in his study observed that all external ear biometric measurement comparison of both ears in two subpopulations of India i.e. North East (NE) and North West (NW), all values were noted more in NW subjects in both genders<sup>8</sup>. For accuracy in plastic reconstruction surgeries and forensic purposes, also for designing ear phones for various companies the accurate knowledge of facial and external ear parameters were very much essential<sup>2</sup>. The external ear dimensions were important variables in evaluation of congenital anomalies like cleft lip/palate, Down's syndrome, chromosomal abnormalities like aneuploidy, also in existence of abnormality of urinary tract<sup>3</sup>. The study carried out by Sidra Shireen *et al* significantly observed right and left external ear differences with higher values in right side along with sexual dimorphism in the dimensions with higher values in males<sup>3</sup>. Sexual dimorphism in the dimensions of external ear may be due to release of more growth hormone in males than females<sup>8</sup>. The same findings in the dimensions of external ear were also observed by Doepa *et al* (2013) in their study on Uttarakhand region<sup>1</sup>. Present study showed that all auricular dimensions are higher in males as compared to females, also significant differences are observed in right and left sides.

## CONCLUSION

The present study provides the mean values of external ear dimensions of right and left ears of students of PIMS and R, Islampur. These values may provide significant information required for supportive evidence in forensic field, diagnosis of congenital malformations of ear. So this information can be used in plastic reconstruction surgeries, designing hearing aids, head phones.

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