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Original research article

Morphometric study of external ear for stature estimation and sexual dimorphism among students of Government Medical College, Baramulla

Berjina Farooq Naqshi[1], Syed HinaMumtaz[2], Baseerat Rashid[3]

[1]Assistant Professor, Department of Anatomy, Government Medical College, Baramulla

[2]Assistant Professor, Department of Forensic Medicine and Toxicology, Government Medical College, Baramulla

[3]Senior Resident, Department of Anatomy, Government Medical College, Baramulla

Corresponding author: Syed Hina Mumtaz, Assistant Professor, Department of Forensic Medicine and Toxicology, Government Medical College, Baramulla

ABSTRACT

Background:

Anthropometry being an important technique to depict the variations in humans and it can be of use for surgical procedures pertaining to reconstructive methods and it has important use in identification process which is an important tool in Forensic Medicine and Toxicology. Morphology of human ear is important for the designing of hearing aids, various syndromes and surgical reconstructions. Our study is being conducted to know the variations in the morphometry of external ear of medical students of GMC Baramulla.

Aim:

To determine morphometric parameters of external ear for stature estimation and to find out sex related differences in dimensions of external ear.

Materials and methods:

Our study was carried out on 66 1st year students comprising 33 males and 33 females of age group from 19 to 22 years in the Department of Anatomy, GMC Baramulla. The study participants included only M.B.B.S students. All parameters were measured by using Vernier caliper. Mean, SD, t value and p value were calculated.

Observations and Results:

A total of 66 students were taken and it was observed that mean right and left ear length in males were 57.5± 0.895 mm and 56.3± 0.718 mm and that for females were 56.9 ±0.809 mm and 56.1±0.439 mm respectively. From the calculations, we have arrived with the conclusion that all the measurements were larger in males as compared to females and right side measurements were higher as compared to left side.

Conclusion:

Out of all the measurements taken, it was observed that values were higher for males as compared to females. Measurements of external ear may be helpful in plastic reconstructive surgeries in congenital ear anomalies and for manufacture of hearing aids

KEY WORDS: Morphometry, stature, external ear, dimorphism

INTRODUCTION:

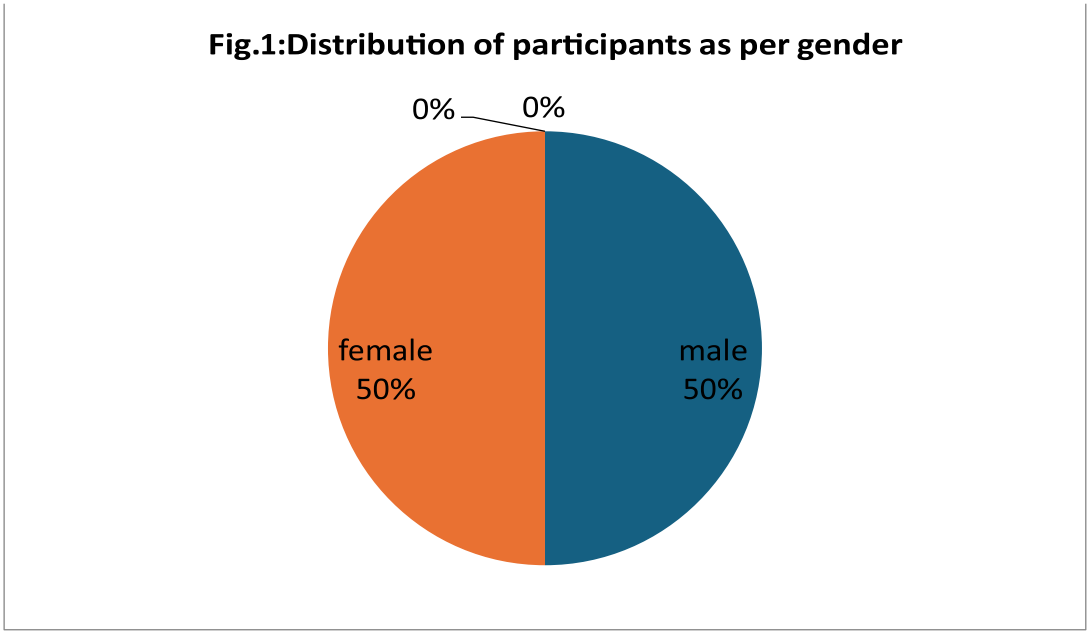
Anthropometry is the measurement of dimensions of human body for understanding of physical variations in humans. These measurements have a vital role to play in the field of prosthetics and plastic surgery (1,2). Fragmented parts like a part of face or decapitated head whenever bought for examination, becomes very difficult for forensic expert to estimate the stature and establish identity. In that case, stature estimation can be done from cephalofacial dimensions which also includes external ear morphometry (3-8).

The External ear is formed of external auditory meatus, external auditory canal and pinna. Pinna is formed by the helix-anti- helix complex, the conchal complex and tubule. Most defining part of the face is human ear (9). Personal identification of humans is quite easy by the utilization of knowledge regarding the anatomical structure of the external ear (10). Morphometric knowledge of auricle is very important for the facial rejuvenation and treatment of auricular dimensions (11). Auricular dimensions are most useful for forensic specialist for the identification process and manufacturer requires them for making ear prostheses (12). Various anomalies related to ears like small ears, absent external ears, large or prominent ears can be there due to trauma, surgical procedures, congenital abnormalities etc (13). In trisomy 13-15, we can have dysplastic ears and their rectification requires cosmetic surgeries after proper morphometry is done (14). Researchers are of the opinion that complete three dimensional structure of ear can be restored if we have proper knowledge pertaining to morphometry (15). The operating surgeon should be well versed with the normal ear dimensions and conformations and that is possible only if he is well versed with its morphometric dimensions (16).

Since the data available is very less related to morphometric study pertaining to external ear. Thus, we have tried to provide the maximum available data that we gathered. This data will be useful to surgeons especially plastic surgeons who face challenging tasks in reconstructive surgeries. Our study might facilitate the process of identification of individual proving extremely fruitful to people from Forensic Medicine and Toxicology.

MATERIALS AND METHODS

Our study was carried out in the Department of Anatomy on 66 first year MBBS students between 19-22 years of age. Among them 33 students were male and 33 were female (Fig.1). They are all students of Government Medical College, Baramulla. Students having any congenital deformity, trauma, tumors, were excluded from the study.



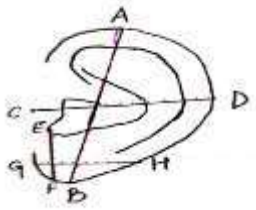
Sample size was calculated using open epi software and using mean and SD from a study conducted by Patel SI etal, sample of 66 was obtained. Sampling method used was stratified sampling method. Written consent was taken from all the students under study. The purpose of our study was explained to them. The students were made to sit on a chair in a Frankfurt plane i.e. the lower border of orbit is in the same horizontal plane as the external acoustic meatus. Auricles of students were measured by means of standard Vernier Calliper that measures 0.1 mm. Study period was from 1st May to 31st July 2024 (03 months). Data was collected from the following measurements:

a) Total ear height (TEH)
b) Total ear Width (TEW)
c) Lobular length (LL)
d) Lobular Width (LW) and all these measurements were taken while the student was in proper anatomical position.

Total ear height (TEH) was measured from highest point of pinna to lowest point of pinna. Total ear width (TEW) was measured from anterior to posterior points of pinna. The lobular length (LL) was measured from midpoint of base of intertragic notch to lowest point of lobule.
Lobular width (LW) was measured as transverse distance of ear lobule passing through centre of length of lobe (Fig.2). Using SPSS version 16.0, data was analysed. Comparisons of the measurements according to sex was done using independent samples. Test comparison of measurements of right and left ears was performed by using paired samples test.

Fig .2 depicts various morphometric measurements done

A to B is total ear length C to D is total ear width
E to F is lobular height
G to H is lobular width



All the measurements were done in a well ventilated and well lit area. All measurements were done by the same person to avoid any bias. All the measurements were done twice in each subject to prevent any disparity

RESULTS

As per our measurements, the results, according to gender we got were that the dimensions of external ear were higher in males as compared to females except for the lobular height of right side. Moreover, the right side measurements were more when compared to the left side measurements (Table 1 and Table 2).

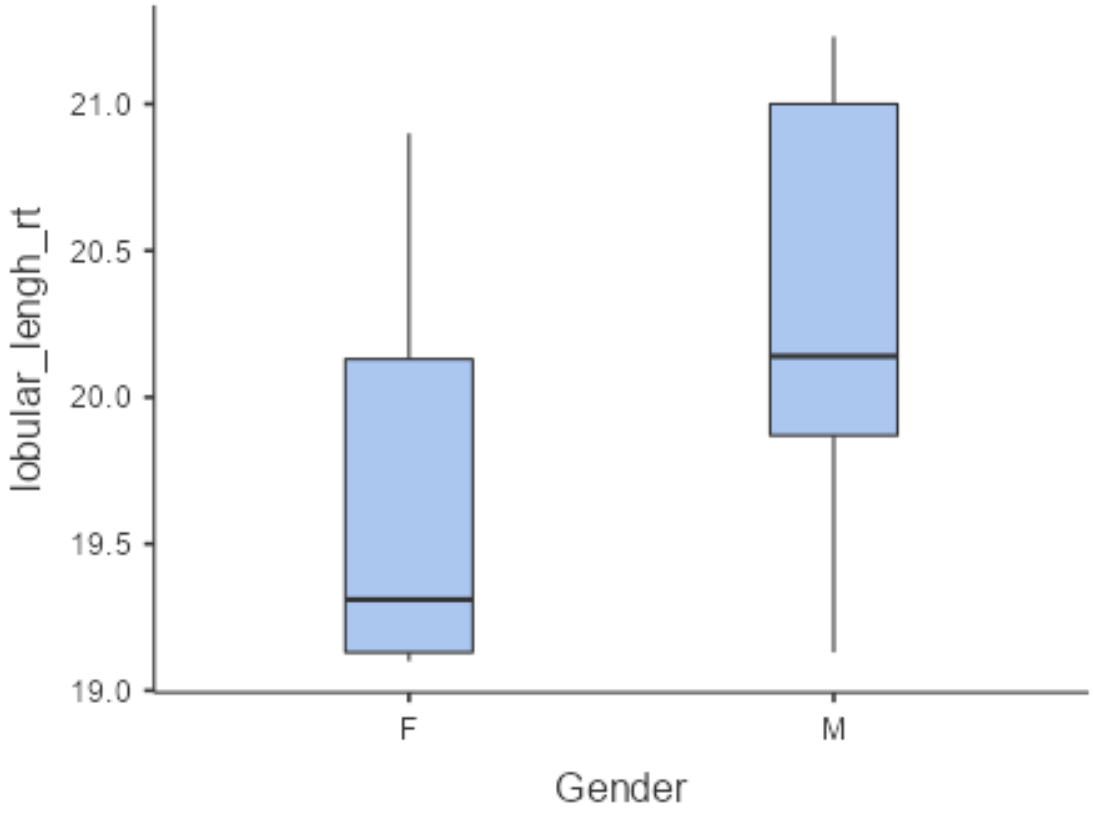
Table no 1: Comparison of different parameters of right ear(Male/Female)

Parameter	gender	mean	Median	SD	
Total Ear height(rt)	F M	56.9 57.5	56.8 57.6	0.809 0.895	Mean difference= -0.629 t= -4.23 p< 0.001
Total ear width(rt)	F M	26.1 26.5	26.1 26.3	0.756 0.649	Mean difference= -0.365 t= -2.98 p= 0.003
Lobular length(rt)	F M	19.6 20.3	19.3 20.1	0.584 0.625	Mean difference= -0.672 t= -6.38 p< 0.001
Lobular height(rt)	F M	19.0 17.6	17.2 17.8	0.312 0.456	Mean difference= -1.329 t= -1.16 p= 0.249

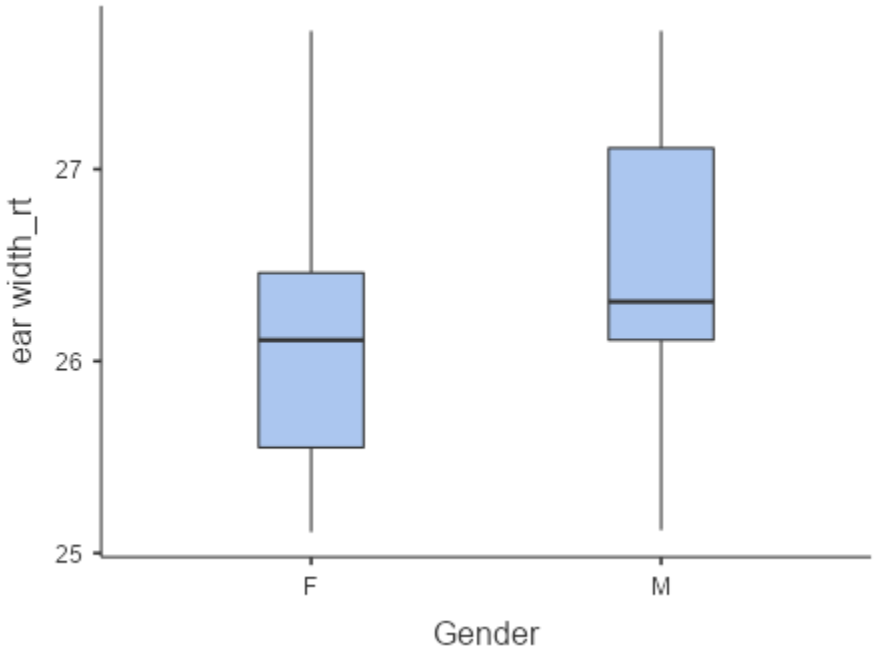
Table no 2: Comparison of different parameters of left ear (Male/Female)

Parameter	gender	mean	median	SD	
Total ear height(lt)	F M	56.1 56.3	56.1 56.2	0.439 0.718	Mean difference= -0.227 t= -2.19 p= 0.030

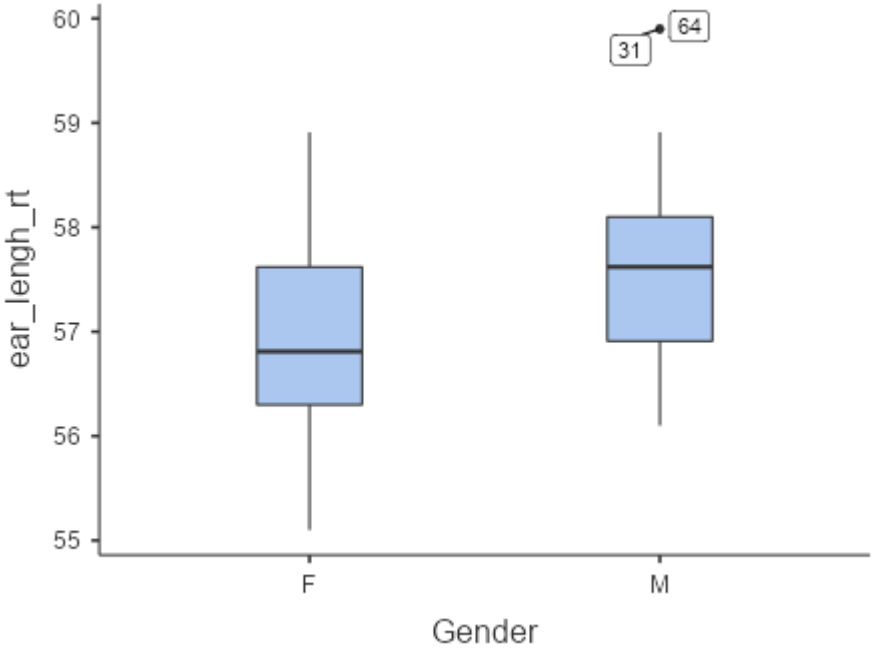
Total ear width(lt)	F	24.9	24.8	0.431	Mean difference= −0.212
	M	25.1	25.1	0.363	t= −3.06 p= 0.003
Lobular length(lt)	F M	19.4 20.3	19.2 20.1	0.448 0.629	Mean difference= −0.872 t= −6.17 p<0.001
Lobular height(lt)	F M	17.3 17.4	17.2 17.2	0.674 0.459	Mean difference= −0.156 t= −1.56 p= 0.122



The box plot compares the lobular length of right ear between male (M) and (F) participants. The median lobular height is nearly identical for both genders, sitting just below 17.5mm. This may reflect a greater range of smaller lobular heights in females as compared to males. There are no apparent outliners in either group, indicating a relatively consistent distribution of measurements.



The box plot compares the right ear width between male (M) and female (F) participants. The median for males is 26.3 and for females, it is 26.1.



The box plot compares the total ear height, also called as ear length of left ear between male (M) and female (F) participants. The median length for males is 57.6 (with two outliers of 31 and 64) and for females its 56.8

DISCUSSION:

In the evaluation of Downs syndrome, total ear height plays a vital role (17). The ear is an under recognized organ whose shape is very important and it gives an accurate idea pertaining to sex and age of an individual(18).Earlier ear parameters were useful for the treatment of various congenital deformities and the reconstructions but with the fast development of forensic medicine, ear parameters make a significant contribution in providing information pertaining to age and sex, hence facilitating the process of identification(19).Bertillon, while working on anthropometry and anthroposcopy referred to individuality of external ear. He stated that no two ears can be similar (20).The death of infamous smuggler namely Verappan was established using the morphology of ear. Huge square shaped lobule with flat tragus contiguous with curved portion of helix gave his ear a unique shape, thus helping in his identification (21).

Brucker et al.(2003) did morphometric study on external ear and obtained a mean total ear height of 6.30 cm and an average lobular height of 1.88 cm. His observations were that the total ear height was larger in men and their lobular width and lobular height was similar to women (22).Sexual dimorphism was documented in external ear dimensions by Sidra et al(18).
Brucker et al.(2003) stated that in auricular dimensions sexual dimorphism does exist with males showing values more than females. This difference was due to the fact that auricular expansion starts earlier in males as compared to females (22). In a study done by Asai et al, comprising of North American whites, it was calculated that total height of left ear in men was 62.4mm and that of females was 58.5 mm which was again in coherence with our results (23).
One more study in favour of our results was the study of Bozkir et al, where he again laid stress on values being higher in males as compared to females i.e.63.1 mm was height of the left ear in men and it was 59.7mm in case of females (24).Ferrario et al found that measurements for males were more as compared to females (25). Higher values for males were seen in study of Barut and Aktunc (26). In their study, a significant finding was that left ear values were more than right ear values (26).
Our study also encourages the study of ito et al (27) who helped in estimating age and sex of individual using external ear morphometry and the dimensions in males were higher than females like that of our study. There is lot of discrepancy in the values for different ear measurements among different studies. There can be various factors attributing for that like race, environmental, age related, based on individual composition etc.

CONCLUSIONS:
The external ear morphometry help in age estimation of individuals. It is useful for the forensic experts as age dependent changes in lobules have influence on individual identification. Its

knowledge can be of use in hearing instruments industry for the manufacture of hearing aids. Ear measurements may serve as a useful tool for determination of sexual dimorphism in cases where identity is unknown. Our study provides mean ear dimensions of right and left ear of students of GMC, Baramulla

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CONFLICT OF INTEREST: None.

ETHICAL APPROVAL:Approved

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