ANTHROPOMETRIC MEASUREMENTS OF EXTERNAL EAR OF MEDICAL STUDENTS IN RUPANDEHI DISTRICT OF NEPAL

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ABSTRACT

INTRODUCTION

Anthropometric refers to the measurements of living human body dimensions for the purpose of understanding human physical variation as it plays major role in prosthetics, plastic surgery. This study aimed to measure the external ear dimensions of medical students in the Rupandehi district, Nepal.

MATERIAL AND METHODS

This was a cross-sectional study conducted among 100 medical students within October to January 2022 at the Anatomy department of UCMS, Bhairahawa. Samples where MBBS studying students aged 18-21 years enrolled in UCMS. Data were analyzed using SPSS version 22.0. Ear measurements, including total ear length and ear width, were taken using a vernier caliper.

RESULTS

All parameters, including ear length, ear width, lobular length, and lobular width, were larger in males compared to females and were significantly larger on the right side than the left. The difference in ear length ($p = 0.00834$) and ear width ($p = 0.00004$) between males and females was statistically significant, with males having longer and wider ears on average.

CONCLUSION

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

KEYWORDS

Anthropometry, External ear, Vernier caliper, Hearing aids

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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 major role in prosthetics, plastic surgery. 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 of its structure. The human ear is divided into external, middle and internal parts. Pinna and 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 Abeyesekera and Shahnavaz (1989) who stated that a piece of equipment designed to fit 90% of the male of 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. Also added that anthropometric data vary considerably for individual within a family or a nation and between nation.[2] Anthropometric studies of the external ear from different parts of the world prove that much variability exists depending on the age, sex and ethnic group, and even in the same person between the right and left ears.[3] In spite of this, the available literature suggests that males have larger ears than females, the length and width of the ear keep on increasing with age, and the general size of the ear varies in populations of different ethnicities.[4]

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.[5] The current study provides information of dimensions of total ear length and ear width of both sides in males and females of age group 18-21 years. 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. Ear anthropometry is a vital feature for face detection, identifying age and gender in forensic investigation.The external ear consists of the external auditory meatus and the auricle or pinna. The latter is most commonly associated with congenital abnormalities such as microtia, macrotia, malposed ear, accessory auricle, lop ear and protruding ear; which may be associated with Down's syndrome, Potter's syndrome and Turner syndrome. Acquired defects result from traumatic injuries and pathologic conditions, especially cancer. Five to eight percent of all skin cancers are located on the auricle as its projection and exposure make it more prone to actinic damage. Rectifying these abnormalities requires information about normal auricular dimensions, the auricle's bilateral position on the face and general conformation. Some studies of the ear involving syndromes and anomalies have been published, but few studies have investigated the ear in the normal population.[6,7] The current study provides information of dimensions of total ear length and ear width of both sides among medical students in relation to males and females of age group 18-21 years. 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.

MATERIAL AND METHODS

A descriptive cross-sectional and inferential study in Anatomy department. Through lottery method of sampling among 100 medical students, 50 were male students and 50 were female students. Sample size was calculated using formula $N= (Z)^2pq/ d^2$ with 95% of confidence interval, 5% of margin error and 9.42% was estimated proportion in population.[1] These all are students of I and II MBBS of Universal College of Medical Sciences and Research Centre, Bhairahawa, Rupandehi. Students with congenital deformity, tumour, trauma, or previous surgery to pinna were excluded. Written and verbal consent was taken. Ethical approval was taken from the institutional review committee (UCMS/IRC/162/21) of Universal College of Medical Sciences, Bhairahawa, Nepal.

Anthropometric measurements

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). Auricle width was measured as the distance from (C), the most anterior and (D) most posterior point of the auricle. Lobular height was measured as a distance from point (E) on intertragic notch to lower point on lobule (B). Lobular width was measured as distance from point (F) to (G).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.

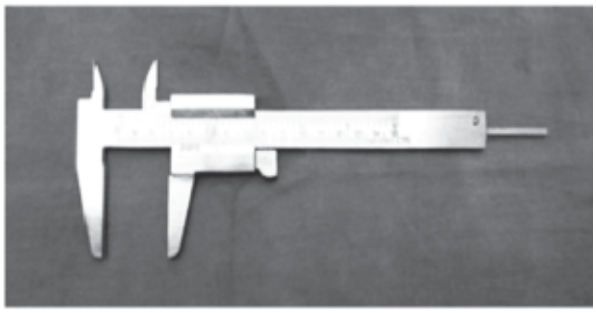

Figure 1. Vernier calliper

Students pursuing I and II year MBBS in UCMS college were included in the study. Students not giving consent, studying other than MBBS and aged below 18 and above 21 years were excluded from the study.

Data have been collected by measuring ear with vernier calliper. Data were entered into the Statistical package for the social sciences (SPSS) version 22 for analysis. Mean and Standard deviation was obtained for categorical variables. Comparisons of the measurements according to sex were done by using an independent sample t-test. Comparison of measurements of right and left ears were performed by using paired samples t-test.

Figure 2. Point from which various measurements were taken

Auricle height (AH) from point A-B
Auricle width (AW) from point C-D
Lobular height (LH) from point E-B
Lobular width (LW) from point F-G

Figure 3. Measuring height of auricle

Figure 4. Measuring height of lobule

RESULTS

Table 1. Sex wise comparison of anthropometric measurements of right ear (n=100)

Variables	Ear length (mm)		Ear width (mm)		Lobular height		Lobular width	
	Male	Female	M	F	M	F	M	F
Mean±SD	59.58 ±	57.71±	28.74±	25.62±	18.21±	18.1±	22.3±	19.3±
	3.51	2.96	2.16	2.46	2.72	2.32	2.7	1.88
p-value	0.00834*		0.00004*		0.4257		0.0013*	

Table 1 shows that males have significantly longer ear lengths (59.58 mm, p=0.00834), greater ear widths (28.74 mm, p=0.00004), and larger lobular widths (22.3 mm, p=0.0013) compared to females. There is no significant difference in lobular height between males and females (p=0.4257).

Table 2. Sex wise comparison of anthropometric measurements of left ear (n=100)

Variables	Ear length (mm)		Ear width (mm)		Lobular height		Lobular width	
	Male	Female	M	F	M	F	M	F
Mean±SD	58.30 ±	57.30±	28.73±	25.70±	18.01±	17.47±	22.1±	19.72±
	3.81	3.04	2.32	2.40	2.71	2.22	2.49	2.31
p-value	0.8543		0.00003*		0.34458		0.00603*	

Table 2 shows that the only notable difference is in ear length between sexes, with males having a mean ear length of 59.98 mm and females 58.30 mm; this difference is close to being statistically significant (p=0.05433).

Table 3. Comparison of anthropometric measurements of right ear versus left ear among male students

Variables	Ear length (mm)		Ear width (mm)		Lobular height		Lobular width	
	Male	Female	M	F	M	F	M	F
Mean±SD	58.98 ±	58.30±	28.74±	28.73±	18.02±	18.01±	22.30±	2.11±
	3.51	3.82	2.16	2.32	2.71	2.71	2.70	2.49
p-value	0.05433*		0.08095		0.27219		0.5792	

Table 3 shows a near-significant difference in ear length between males (59.98 mm) and females (58.30 mm) with a p-value of 0.05433. Other measurements, including ear width, lobular height, and lobular width, do not show statistically significant differences.

Table 4. Comparison of anthropometric measurements of right ear versus left ear among female students

Variables	Ear length (mm)		Ear width (mm)		Lobular height		Lobular width	
	Male	Female	M	F	M	F	M	F
Mean±SD	57.71 ±	57.30±	25.62±	25.70±	18.11±	17.47±	19.30±	19.72±
	2.96	3.04	2.46	2.40	2.32	2.22	1.88	2.31
p-value	0.32445		0.15820		0.30793		0.15138	

Table 4 shows that there are no statistically significant differences in ear morphometric measurements between males and females, with all p-values greater than 0.05.

DISCUSSION

In the present study, Vernier Calliper (Figure 1) was utilized for anthropometric measurements. Points for measuring auricular height, width, and lobular height and width (Figure 3) and measurement procedure (Figures 3 & 4) are mentioned. According to Itoh I et al (2001), in case of male, the external ear acquires its mature height at 13 years and in females at the age of 12 years.[5] The differences in the dimensions of external ear were determined by several authors, with higher values in males as compared to females.[6,7] 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.[8] Ekanem et al (2010) stated that all the values of pinna are higher in males as compared to females.[7] According to Itoh I et al (2001), males and females reach the mature height of their external ear at different ages-13 years for males and 12 years for females. This slight difference in the timing of growth spurts may contribute to the differences in ear dimensions observed later in life. Sexual dimorphism, which refers to the differences in size and appearance between males and females of the same species, is a common phenomenon in humans. These differences can be influenced by genetic, hormonal, and environmental factors. Several studies, including those by Bozkir et al (2006)[8] and Ekanem et al (2010)[7] have documented that males tend to have larger ear dimensions than females. This can be due to the differential effects of sex hormones, such as testosterone and estrogen, on

the growth of cartilaginous structures during puberty. Genetic predispositions can play a significant role in determining the size and shape of the external ear. Studies conducted on different populations, such as the Turkish and Japanese populations by Bozkir et al (2006),[8] highlight that genetic background can influence ear dimensions, and these genetic traits are often expressed differently in males and females. Anthropometric variations refer to the differences in body measurements and proportions among individuals and populations. These variations can be influenced by a combination of genetic, environmental, and cultural factors. Studies have consistently shown that anthropometric measurements, including those of the external ear, tend to be larger in males. This can be linked to overall body size differences between the sexes, where males generally have larger body dimensions. Hormonal influences, particularly during puberty, can affect the growth and development of various body parts, including the ears. Testosterone, which is more prevalent in males, can stimulate the growth of cartilage and other connective tissues, potentially leading to larger ear dimensions.

Sharma and 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.[3,9] 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.[3] 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.[4] 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.[4] The same findings in the dimensions of external ear were also observed by Doepa et al (2013) in their study on Uttrakhand region.[1] Present study showed that all auricular dimensions are higher in males as compared to females, also significant differences are observed in right and left side. Present study alligns with the study which observed that earlobes tend to elongate and become wider with age, likely due to changes in skin elasticity and the effects of gravity. These findings are significant for clinical applications, such as planning reconstructive and aesthetic surgeries and designing prosthetic earlobes. The research provides normative data and standard measurements that can be used as a reference in clinical practice, highlighting the importance of individualized approaches in earlobe-related procedures.[10]

Since the study is observational and cross-sectional, it can establish associations but not causations. Also, longitudinal studies are needed to better understand the causal relationships.

This study has limited sample size which lacks diverse demographic representation affecting the reliability and generalizability of the findings. Selection bias, measurement bias, and reporting bias could affect the results and interpretations of these studies. Additionally, anthropometric measurements can be influenced by socioeconomic factors such as nutrition, healthcare access and lifestyle. The study may not have controlled for these variables, which could confound the observed differences between male and female respondents.

CONCLUSION

The present study provides the mean values of external ear dimensions of right and left ears of medical students of UCMS, Bhairahawa. 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.

CONFLICT OF INTEREST

None

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REFERENCES

1. Deopaa D, Thakkar HK, Prakash C, Niranjan R, Barua MP. Anthropometric measurements of external ear of medical students in Uttarkhand region. Anatomical Society of India. 2013;62:79-83.
2. Abeysekera JD, Shahnavaz H. Body size variability between people in developed and developing countries and its impact on the use of imported goods. Int J Ind Ergon. 1989;4:139-49.
3. Sharma N. Anthropometric measurement and cross-sectional surveying of ear pinna characteristics in Northern India. J Exp Clin Anat. 2016;15:102-6.
4. Shireen S, Karadhelkar VP. Anthropometric measurements of human external ear. J Evol Med Dent Sci. 2015;4(59):10333-8.
5. Itoh I, Ikeda M, Sueno K, Sugiura M, Suzuki S, Kida A. Anthropometric study on normal human auricle in Japan. Nippon Jibiinkoka Gakkai Kaiho. 2001;104(2):165-74.
6. Brucker MJ, Sullivan PK. A morphometric study of the external ear: age and sex related differences. Plast Reconstr Surg. 2003;112:647-52.
7. Ekanem AU, Musa TS, Dare ND. Anthropometric study of the pinna among adults Nigerians resident in Maiduguri metropolis. J Med Sci. 2010;10(6):176-80.
8. Bozkir MG, Yavuz M, Dere F. Morphometry of external ear in our adult population. Aesth Plast Surg. 2006;30:81-5.
9. Verma P, Gupta Verma K, Goyal S, Sudan M, Ladgotra A. Morphological variations and biometrics of ear: An aid to personal identification. J Clin Diagn Res. 2016;10(5):138-42.
10. Azaria R, Adler N, Silfen R, et al. Morphometry of the adult human earlobe: a study of 547 subjects and clinical application. Plast Reconstr Surg. 2003;111:2398-402.