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Anatomy

# VARIATION OF EAR PARAMETERS AMONG ANNANG ETHNIC GROUP OF NIGERIA

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**ABSTRACT** The study was to establish the normative morphometric ear properties and height of Annang ethnic group of South-South Nigeria, highlight differences between sexes and changes with age. A total of 400 subjects (233 females and 167 males) of 16-80 years of age which met the inclusion criteria were used. Standardized measurement of human height, total ear height and width, concha height and width, lobar height and width and ear projection were taken. Data were analyzed using Statistical Package for Social Sciences (SPSS) Version 23. The mean human height was 1.61±0.08m. Total ear height, concha height and lobar height were 57.52±4.48mm; 26.2±12.89mm and 14.92±2.74mm, respectively. Total ear width, concha width, lobar width and ear projection were 34.19±3.55mm; 18.92±2.15mm; 14.01±3.61mm and 17.00±2.42mm, respectively. Ear parameters were higher in the males except for lobar width ($p< 0.05$). The total ear height, lobar height and width increased with age ($p<0.05$). Age positively correlated with right ear height with r value of 0.321 in males and 0.432 in females. The incidence of ear prominence was 7.5% in the general population. Among the Annang ethnic group, human height had a low positive correlation with total ear height.

**KEYWORDS :** Annang, Human height, External ear parameters

## INTRODUCTION

The external ear or pinna is primarily made of the helix-antihelical complex, the conchal complex and the lobe (Taura *et al.*, 2013; Shireen and Karadkhelkar, 2015). The surface facing outward is irregularly concave with many elevations and depressions. It serves the function of receiving sound waves for onward processing in the inner ear (Umar *et al.*, 2017).

Human identification being the backbone of legal and forensic matters can be established by highlighting the characteristics that set individuals apart (Zulkifli *et al.*, 2014). The gross anatomy of the pinna and its somatometric data was first used by the French criminologist, Bertilion, as a means to determine identity and individuality (Singh and Ruma, 2006;Verma *et al.*, 2016). The ear has been used in sex identification and age estimation because its subtle structures show signs of age and sex. However these are not easily delineated (Ekanem *et al.*, 2010; Depo *et al.*, 2013; Morgod *et al.*, 2013; Taura *et al.*, 2015). Ear size is reported to increase in size with age (Shireen and Karadkhelkar, 2015). The uniqueness of the ear may be used by psychologists to aid the identification of personality disorder and assessing family relationships (Laxmi *et al.,* 2107). Age, gender, ethnicity, socioeconomic status, environment and region are some factors responsible for the variability of the pinna (Sadacharan, 2016). This serves as a basis for anatomical research (Umar *et al.*, 2017).

The external ear has a huge influence on individual appearance and beauty as malformed and mal-positioned auricle can mar one's appearance (Sharma, 2016). Prominent ears (ear helix – mastoid distance > 21mm at the level of the lower border of the tragus) frequently are the most occurring congenital abnormality of the external ear with its attendant profound psychological effects (Muteweye and Muguti, 2015). Skin cancers may be noticed early on the external ear in five to eight percent of cases because of its susceptibility to actinic damage due to its exposure and projection (Japatti *et al.*, 2018).

Ear size and location can also be used in differentiating between ethnic groups. Various dimensions of the external ear have been studied in different groups such as Indians (Murgod *et al.*, 2013;Shireen and Karadkhelkar, 2015; Verma *et al.*, 2016; Laxmi *et al*., 2107; Umar *et al.*, 2017), Chinese (Zhao *et al.,* 2017), ethnically diverse United Kingdom population (Alexander *et al.*, 2010), Indian Americans (Sadacharan, 2016) and Sudanese (Ahmed and Omer, 2015). A piece of equipment like prosthesis designed for a particular group of people would not be a perfect fit for others thus specific and accurate biological data should be documented per population (Deopa *et al.*, 2013; Ahmed and Omer, 2015). The need for ethnic anthropometric parameters is necessary for identification, optimization of equipment and surgical ear reconstruction.

This study was aimed at determining the anthropometric measurements of the external ear of the Annang ethnic group of South-South geopolitical zone of Nigeria, estimation of height from total ear height, determining a correlation between ear parameters and investigating the incidence of prominent ears.

## MATERIALS AND METHODS

The study group consisted of 400 volunteers (235 females and 167 males) of the Annang ethnic group of Akwa Ibom State, Nigeria of 16 – 80 years of age and was conducted between the period of April to July 2018. The minimum sample size (n) was calculated using the Sloven's formula; $n = N/[1+N(e^2)]$ where N is the population size = 1750160 (Federal Republic of Nigeria official gazette, 2006) and e is the level of significance (= 0.05).

Participants were randomly selected from Local Government Areas in the Annang ethnic group. Participants were also of dual parentage from the Annang ethnic group with no malformation and no ear injuries or surgeries. The study was explained and standard informed consent were obtained from volunteers before the measurements were taken.

Subjects were positioned in the Frankfort plane before the following standard measurements of the height and external ears (left and right) were taken using the landmark point defined by Ekanem *et al*. (2010); Muteweye and Godfrey, (2015); Verma *et al.* (2016) and Udoh *et al*. (2017).

**Height**: This was measured as the vertical distance between the heel and the vertex of an individual standing upright with the feet placed together, upper limbs dangling on the side and the head held in a Frankfort plane.

**Total Ear Height (THE)**: The distance from the most superior projection to the most inferior projection of the helix.

**Total Ear Width (TEW):** The distance between the maximum convexity of the helix and root of the ear.

**Concha Height (CH):** The longitudinal distance between the intertragic incisures and cymba concha.

**Concha Width (CW):** The distance between the maximum convexity of the antihelix and the posterior margin of the tragus.

**Lobar Height (LH):** The distance from the inferior end of the lobule to the base of the tragal notch.

**Lobar Width (LW):** The width of the lobule at the midpoint of the lobar height.

**Ear Projection (EP)**: The distance from the ear helix at the lower border of the tragus (lobule) to the mastoid process.

All ear parameters were manually taken using Neiko 01407A stainless steel digital calipers with extra-large LCD (liquid crystal display) to the nearest 0.1mm while height was measured using a stadiometer. All measurements were taken twice.

The numerical data were collected and analyzed using Statistical Package for Social Sciences (SPSS) Version 23. Analysis of age and sex variations was done using paired T test and Pearson's correlation test for linear relationship. Values of $p< 0.05$ were considered significant.

## RESULTS

The results for all the ear parameters and height of both sexes are shown in Table 1. The combined mean height and standard deviation was 1.61±0.08m. The total ear height and total ear width in the combined population were 57.52±4.48mm and 34.19±3.55mm, respectively. The mean and standard deviation of the other ear variables from both sexes were: concha height 26.2±12.89mm; concha width 18.92± 2.15mm; lobar height 14.92± 2.74mm; lobar width 14.01± 3.61mm and ear projection 17.00 ±2.42mm. The ratio of the total ear height to concha height was 46% while the total ear height to lobar height was 26%.

Table 1 shows the differences in height and ear anatomy with respect to the male and female subgroups. The mean lobar heights for both sexes were 14.98± 2.85mm in males and 14.88± 3.55mm in females. The mean ear variables were higher in males when compared to those of the female except for lobar width where the males had 13.66± 3.65mm and the females had 14.28± 3.55mm. The mean height were 1.66± 0.07m and 1.58± 1.80m for males and females, respectively. Also the mean total ear height and total ear width for males and females were 58.90± 4.05mm; 56.52± 4.68mm and 35.13± 3.01mm; 33.51± 3.76mm, respectively. Concha height and width for males were 27.13± 2.71mm and 19.08±2.29mm while those of females were 25.55± 2.81mm and 18.81± 2.04mm.The mean ear projection distances were 17.12± 2.46mm and 16.61± 2.39mm in males and females, respectively.

The maximum height values were similar in both sexes; the males had 1.82m while the females had 1.80m. Females had both minimum and maximum measured values in the following ear parameters, total ear height, total ear width, concha height and lobar height. The highest measured values for lobar width were similar in males and females, 24.4mm and 24.0mm, respectively. The values for total ear height were between 48.3mm - 69.6mm in males and between 44.3mm - 72.9mm in females. Total ear width ranged from 26.6mm to 43.9mm and 23.4mm to 59.0mm for males and females, respectively. Ear projection was 4.5mm to 26.7mm in males and 8.1mm to 25.9mm in females.

Differences between the left and right ears were also analyzed as shown in Table 2. It was seen that the right ear had higher mean values compared to the left ear except for the lobar height which was equal in both sides with a value of 14.92± 2.81and 14.92± 2.67 in the right and left ears, respectively. The mean lobar width was more on the left with a value of 14.18± 3.84mm compared to the right with 13.84± 3.37mm. In addition, the ear was more projected on the left side with a value of 17.06± 2.35mm compared to the right side that had 16.93± 2.49mm. The right and left total ear height had almost similar maximum values of 72.9mm and 72.7mm. The right and left maximum lobar width were 24.0 and 24.4mm, respectively.

There were strong correlations between all the ear parameters on the right and left sides with significance at $p< 0.01$ as shown in Table 2. The right and left total ear height had the highest correlation of 0.914 and 0.939 in the males and females, respectively while the lowest r value was between the right and left concha width at 0.760 and 0.811 in males and females. There was a strong correlation between ear variables. The highest correlated parameter was between total ear height and lobar height with a r value of 0.641 in males and 0.639 in females. The least correlated value was 0.48 between the total ear height and concha height in both sexes. Both concha width and lobar width correlated with total ear width at a r value of 0.50 and 0.51 in males and females, respectively.

Age positively correlated with right ear height with an r value of 0.321 in males and 0.432 in females. It also correlated with right lobar height with an r value of 0.364 in male and 0.341 in the female population at a $p< 0.01$. A positive but low correlation between ear height and human height were calculated in both sexes (0.27 in males and 0.17 in females).

To evaluate the age related changes, the cohort was divided arbitrarily into 7 groups based on the age distribution (Ekanem *et al*., 2010), separately for the right and left ears as shown in Table 3. There were no significant changes in the total ear width, concha height, concha width between the age groups 16-20years through 61-70years. In all the age subgroups, there was a gradual increase in total ear height, lobar height, lobar width and ear prominence from 55.81mm to 63.44mm, 13.65mm to 17.65mm, 12.52mm to 16.70mm and 16.02 and 19.46mm, respectively. Also all ear parameters measured were highest in the 71-80year age groups.

Concerning ear prominence, 7.8% of the males had prominent right and left ears while 7.3% and 6.4% of the females had prominent right and left, ears respectively. When combined 7.5% of the population had prominent ears.

**Table1:The Mean±SD and range of ear parameters across the sample with respect to sex.**

| Sex | N | Parameter | Height (m) | Total Ear Height (mm) | Total Ear Width (mm) | Concha Height (mm) | Concha Width (mm) | Lobar Height (mm) | Lobar Width (mm) | Ear Projection (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| M | 167 | Mean±SD | 1.66± 0.07 | 58.90±4.05 | 35.13±3.01 | 27.13± 2.71 | 19.08±2.29 | 14.98±2.85 | 13.66±3.65 | 17.12±2.46 |
| | | Range | 1.42- 1.82 | 48.3 - 69.6 | 26.6 - 43.9 | 18.2 – 34.6 | 11.9 – 25.5 | 6.4 – 21.2 | 4.4 – 24.4 | 4.5 – 26.7 |
| F | 233 | Mean±SD | 1.58± 0.07 | 56.52±4.68 | 33.51±3.76 | 25.55±2.81 | 18.81±2.04 | 14.88±2.67 | 14.28±3.55 | 16.61±2.39 |
| | | Range | 1.35-1.80 | 44.3 -72.9 | 23.4-59.0 | 14.2 - 36.6 | 14.0 - 24.6 | 8.8 - 22.7 | 6.3 - 24.0 | 8.1 - 25.9 |
| C | 400 | Mean±SD | 1.61± 0.08 | 57.52±4.48 | 34.19±3.55 | 26.21±2.89 | 18.92±2.15 | 14.92±2.74 | 14.01±3.61 | 17.00±2.42 |
| | | Range | 1.35-1.82 | 44.3 - 72.9 | 23.4 - 59.0 | 14.2- 36.6 | 11.9 - 25.5 | 6.4 - 22.7 | 4.4 - 24.4 | 4.5 - 24.4 |

M=male, F=female, C=combined

**Table2: Mean±SD, Pearson correlation between right and left ear parameters of Annangs in Nigeria.**

| Ear Parameters | Sex | n | Mean± SD(mm) | | Range(mm) | | r |
|---|---|---|---|---|---|---|---|
| | | | Right ear | Left Ear | Right Ear | Left Ear | |
| Total Ear Height | Male | 167 | 59.07±4.11 | 58.73 ±3.99 | 48.4- 69.6 | 48.3- 68.9 | 0.914 |
| | Female | 233 | 56.57±4.62 | 56.47±4.73 | 45.5- 72.9 | 44.3- 72.7 | 0.939 |
| | Combined | 400 | 57.62±4.58 | 57.42±4.57 | 45.5-72.9 | 44.3- 72.7 | |
| Total Ear Width | Male | 167 | 35.42±3.11 | 34.84±2.91 | 28.2- 43.9 | 26.6- 41.7 | 0.753 |
| | Female | 233 | 33.71±3.70 | 33.30±3.81 | 24.0- 46.2 | 23.4- 59.0 | 0.813 |
| | Combined | 400 | 34.42±3.56 | 33.95±3.54 | 24.0- 46.2 | 23.4- 59.0 | |
| Concha Height | Male | 167 | 27.31±2.67 | 26.94±2.75 | 20.3- 33.9 | 18.2- 34.6 | 0.797 |
| | Female | 233 | 25.51±2.85 | 25.59±2.77 | 14.4- 35.8 | 14.2- 36.6 | 0.838 |
| | Combined | 400 | 26.26±2.94 | 26.15±2.84 | 14.4- 35.8 | 14.2-36.6 | |
| Concha Width | Male | 167 | 19.36±2.34 | 18.79±2.23 | 12.7- 25.5 | 11.9- 24.2 | 0.760 |
| | Female | 233 | 19.00±2.08 | 18.61±2.00 | 14.0- 24.6 | 14.2- 24.1 | 0.811 |
| | Combined | 400 | 19.15±2.20 | 18.68±2.10 | 12.7- 25.5 | 11.9 – 24.2 | |
| Lobar Height | Male | 167 | 14.98±2.92 | 14.98±2.78 | 6.4- 21.2 | 6.7- 21.2 | 0.749 |
| | Female | 233 | 14.88±2.74 | 14.87±2.60 | 8.8- 22.3 | 9.0- 22.7 | 0.887 |
| | Combined | 400 | 14.92±2.81 | 14.92±2.67 | 6.4- 22.3 | 6.7-22.7 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lobar Width | Male | 167 | 13.45±3.26 | 13.86±4.04 | 4.4- 23.2 | 5.2- 24.4 | 0.880 |
| | Female | 233 | 14.13±3.42 | 14.42±3.68 | 6.3- 24.0 | 6.9- 22.6 | 0.819 |
| | Combined | 400 | 13.84±3.37 | 14.18±3.84 | 4.4- 24.0 | 5.2-24.4 | |
| Ear Projection | Male | 167 | 17.08±2.62 | 17.16±2.30 | 4.5- 26.7 | 11.8- 23.9 | |
| | Female | 233 | 16.23±2.39 | 16.99±2.39 | 8.6- 23.9 | 8.1- 25.9 | |
| | Combined | 400 | 16.93±2.49 | 17.06±2.35 | 4.5- 26.7 | 8.1- 25.9 | |

n = sample size, r = correlation coefficient

**Table 3: The Mean±SD of right and left ear parameters in relation to age in the Annang ethnic group of Nigeria .**

| Ear R/L Ear Parameter | Age group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (mm) | 16-20yr (n=31) | 21-30yr (n=126) | 31 – 40yr (n=119) | 41 – 50yr (n=73) | 51 – 60yr (n=25) | 61 – 70yr (n=13) | 71 – 80yr (n=13) | |
| TEH | Right | 55.95±3.70 | 56.35±4.11 | 57.20±4.50 | 59.31±3.99 | 59.00±5.14 | 61.26±3.62 | 63.69±7.40 |
| | Left | 55.68±3.76 | 56.17±4.08 | 56.93±4.35 | 59.11±4.18 | 58.76±5.67 | 61.45±4.36 | 63.18±3.81 |
| TEW | Right | 34.48±2.72 | 34.32±4.00 | 33.89±2.95 | 34.86±2.58 | 35.35±3.30 | 34.48±4.28 | 37.36±3.81 |
| | Left | 33.79± 2.76 | 33.66±4.16 | 33.60±3.13 | 34.80±3.37 | 34.83±3.08 | 32.66±3.10 | 36.21±2.17 |
| CH | Right | 26.57±2.44 | 26.33±3.16 | 26.30±3.02 | 25.72±2.48 | 26.86±3.18 | 27.27±2.94 | 25.75±2.77 |
| | Left | 26.21±2.39 | 26.21±3.01 | 26.21±2,85 | 26.15±2.64 | 26.78±3.27 | 27.32±3.02 | 24.92±2.11 |
| CW | Right | 19.44±1.84 | 19.04±2.20 | 18.93±2.11 | 19.34±2.32 | 19.86±1.83 | 18.06±3.26 | 20.93±1.98 |
| | Left | 18.80±2.38 | 18.62±2.10 | 18.55±1.94 | 18.86±2.11 | 19.20±1.78 | 17.07±2.08 | 20.71±1.76 |
| LH | Right | 13.78±2.90 | 14.26±2.51 | 14.63±2.55 | 16.18±2.58 | 15.36±2.53 | 16.51±3.35 | 18.65±3.40 |
| | Left | 13.52±2.33 | 14.34±2.58 | 14.83±2.50 | 16.00±2.49 | 15.38±2.48 | 16.66±3.32 | 16.65±2.91 |
| LW | Right | 12.71±3.06 | 12.87±2.96 | 14.37±3.57 | 14.84±3.48 | 15.71±3.17 | 15.26±3.21 | 15.72±2.32 |
| | Left | 12.33±3.14 | 12.79±3.26 | 14.76±3.87 | 15.85±3.94 | 17.69±3.60 | 15.07±3.22 | 17.69±3.78 |
| EP | Right | 15.92±1.78 | 16.43±2.32 | 16.95±2.32 | 17.36±2.41 | 19.24±2.48 | 18.89±3.20 | 19.68±3.90 |
| | Left | 16.11±1.61 | 16.76±2.14 | 17.05±2.21 | 17.45±2.43 | 19.68±2.32 | 17.62±2.47 | 19.23±4.24 |

## DISCUSSION

The external ear is one of the parts of the body that has been studied widely via anthropometry. The present study attempted to investigate some of the fundamental ear dimensions in the Annang ethnic group of Nigeria and compare the results to other populations within and outside the country.

The height of the Annang ethnic group was 166±0.07m in males and 1.58± 0.07m in females which was similar to 165.29±9.98cm in males and 160.36±9.09cm as studied by Udoh *et al*. (2017). Heights of people from the other two major ethnic groups in Akwa Ibom State are 172.05±10.05cm in males and 162.99±7.64cm in females of the Oron ethnic group (Johnson *et al.*, 2018) while 1.67.45±7.03m in males and 1.59±5.14m in females of the Ibibio ethnic group (Edem *et al.*, 2019).

Table 4 illustrates ear differences between populations. Ekanem *et al*. (2010) in Borno State, Nigeria had lesser ear distances. The mean ear height was 5.6cm, lobar height was 1.11cm and lobar width was 1.35cm. Lobar width was more in the female population (Ekanem *et al.*, 2010) unlike the other ear distances that were higher in the males as in the present study. In a study conducted by Sharma *et al*. (2016) in Northern India, the total ear length and width had lower values than the present study except for lobar height which was more in females in both ears. From the North-East population of India (Verma *et al.*, 2016) total ear width, concha height and width were lower than results of the present work while total ear height and lobar width were higher. In the Turkish population, total ear height was higher on the left while the lobar height and width were higher on the right ear (Talisumak *et al*., 2015). In the present study ear dimensions were greater on the right ear except for the lobar height which was similar on both sides. Murgod *et al*. (2013) found that the left ear had higher dimensions among Indians while there was no difference between the right and left ears as studied by Acar *et al*. (2017) in the South-East Nigerians. The Japanese population had an average total ear height of 64.7mm for males and 59.7mm for females (Yamada, 2009). Difference in size of the ear lobe as studied by Umar *et al*. (2017) among the Gujrat Indians was not significant between males and females.

**Table 4: Comparative analysis with results from previous studies on the ear parameters.**

| Source (unit) | Population Studied | Ear Parameters | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | THE | | | | TEW | | | | LH | | | | LW | | | |
| | | M | | F | | M | | F | | M | | F | | M | | F | |
| | | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L |
| Verma et al, 2016(mm) | North- east Indian | 61.58 | 60.03 | 57.51 | 57.51 | 31.46 | 30.72 | 29.48 | 27.97 | 2.78 | 3.37 | 1.74 | 1.86 | 18.92 | 17.90 | 16.45 | 16.13 |
| Verma et al,2016(mm) | North-west Indian | 63.74 | 61.11 | 58.90 | 58.16 | 32.30 | 32.19 | 29.48 | 29.13 | 5.36 | 5.68 | 2.17 | 2.85 | 18.02 | 19.39 | 17.96 | 19.17 |
| Tatlisumak et al 2015 (mm) | Turkey | 64.47 | 65.49 | 60.30 | 61.33 | 35.33 | 33.99 | 32.97 | 32.29 | 18.40 | 18.37 | 17.33 | 17.31 | 19.21 | 17.33 | 18.73 | 17.07 |
| Laxmi et al, 2017(cm) | Northern India | 6.2 | 6.18 | 5.73 | 5.73 | 3.42 | 3.40 | 3.20 | 3.20 | 1.21 | 1.22 | 1.23 | 1.20 | 1.71 | 1.69 | 1.64 | 1.69 |
| Acar et al, 2017(mm) | African students | 58.3 | 58.4 | 55.8 | 54.0 | 33.5 | 32.8 | 28.6 | 28.8 | 17.0 | 17.8 | 18.9 | 19.3 | 19.9 | 19.4 | 20.2 | 20.2 |
| Sharma 2016(cm) | Northern Indians | 5.43 | 5.37 | 5.49 | 5.41 | 2.89 | 2.84 | 2.81 | 2.79 | 1.34 | 1.37 | 1.52 | 1.53 | 1.42 | 1.40 | 1.56 | 1.59 |
| Deopa et al,2013(cm) | Uttarakhand | 6.04 | 6.03 | 5.74 | 5.77 | - | - | - | - | 1.67 | 1.69 | 1.66 | 1.68 | 1.96 | 1.96 | 1.92 | 1.95 |
| Ekanem et al, 2010 (cm) | Madugri metropolis | 5.60 | 5.62 | 5.61 | 5.58 | - | - | - | - | 1.13 | 1.12 | 1.07 | 1.05 | 1.31 | 1.33 | 1.38 | 1.36 |
| Akpa et al, 2013(cm) | South – East Nigeria | 5.98 | 6.02 | 5.94 | 5.96 | 3.18 | 3.22 | 3.02 | 2.98 | - | - | - | - | - | - | - | - |
| Present study(mm) | Annang Nigeria | 59.07 | 58.73 | 56.57 | 56.47 | 35.42 | 34.84 | 33.71 | 33.30 | 14.98 | 14.98 | 14.88 | 14.87 | 13.45 | 13.86 | 14.13 | 14.42 |

In the previous studies sexual dimorphism was seen as also observed in the present study since males had significant higher values compared to the females. The reason for higher ear parameters in males may be linked to earlier auricle expansion in males which continues to a later age (Taura *et al.* , 2013). Results obtained from direct ear measurement such as the present study were comparable to other results where measurements were made using scanning and photographic methods because a single measurer, repeated measurement and adequate knowledge of land marks were used as measures of precaution (Liu, 2007;Taura *et al*, 2013). However, the mean values of ear parameters and indices as reported by scientists vary in different populations which could be attributed to differences in age groups, numbers of subjects and race (Sadachara, 2016)

The ear dimensions studied by Sharma (2016) in Northern India increased with increasing age. This view was also supported by Ekanem *et al.* (2010) and Akpa *et al*. (2013). Alexander *et al*. (2011), however, had significant increase in total ear height, lobar height with age similar to the present study adding that increase in total ear height was largely due to increase in lobar height. According to Meijerman *et al*, (2006) lobar expansion exceeded cartilage expansion thus it contributed greatly to increase in ear height. This change may be attributed to morphological age changes of elastic fibers (Ito *et al.*, 2001). Deopa *et al*. (2013) had significant increase in ear dimensions with age while Brucker *et al*. (2003) found the lobule to significantly increase. These findings corroborated with the current result Prominent ear occurs from the inability of the antihelix to fold which

leads to increase in the conchoscaphal angle and flattening of superior crus, antihelical body and inferior crus. If severe and it affects 5% of the general public according to the American Society of Plastic Surgeons. By five years of age cases of prominent ears cannot be missed by parents. In a study of the Turkish population (Tan and Gault, 1994), male had more prominent ears. In the present study males also had more ear prominence. However, Muteweye and Muguti, (2015) had equal ear projection distances on both ears with the incidence of ear prominence 7.69% in the males, 6.17% in the females and 6.89% in the general sample. In a study by Alexander *et al*, (2011) 42 subjects had ear prominence out of the 420 people studied; 26 were bilaterally prominent while 16 were unilaterally prominent. Though surgical repair can be carried out when the ear is fully mature (between 5 - 7years ), it can be avoided by splintage of the ear in the early neonatal period (Tan and Gault, 1994).

The correlation between age and total ear height were 0.320 in males and 0.432 in females. Taura et al. (2015) obtained a correlation of 0.207 and 0.229 with total ear height and ear width. Also in the study conducted by Merjerman *et al.* (2006) the regression coefficient to show the effect of age on total ear height and lobar length were 0.178 and 0.115mm/yr for males and 0.162 and 0.100mm/yr for females.

## CONCLUSION

This study showed the normative mean height and ear parameters of adults of the Annang ethnic group which vary with sex and age. The results obtained were comparable with those of other ethnic groups except for the incidence of ear prominence. These values could be used as ethnic markers and as well as in clinical settings, forensic applications and manufacture of ear specific gadgets.

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