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# Morphological assessment of Ear auricle in a group of Iraqi subjects and its possible role in personal identification

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Abstract

Ear auricle had been studied many years ago for personal identification. Many studies in different countries had assessed the shape and measurements of parameters. Variance in dimensions of auricle within various age groups, race and genetic background recommended identification of normal range for auricle parameters; that is necessary for aesthetic purposes and anatomical standardization. **Materials and method:** Auricular dimensional parameters in 311 individuals in both right and left sides were measured using Vernier caliber; in addition to shape assessment, and lobular attachment status were recorded. **Results:** Nine parameters were evaluated for auricle morphometry in both sides. In one hand, significant differences were noticed regarding gender in ear height above tragus, tragus span and lobule height on other hand, no significant difference in parameters measurements according to lobule status. Comparing means of parameters among four shapes of auricle the study showed a statistical significance. Significant differences were recorded regarding gender with lobule status and gender with ear shape. Moreover, positive correlations were noticed among many parameters including, concha width and width of ear. **Conclusion:** This study represent a standardization of auricular dimensional parameters among Iraqi sample that is so beneficial in plastic surgery, hearing aids productions and personal identification. Taking in consideration, lobule status, gender, and shape of auricle.

Keywords

Ear auricle, morphometry, anthropometry, personal identification, ear lobule.

## Introduction

The use of ear to identify human started since late 19th century when Alphonse Bertillon considered it as one of anthropometric measurements for identifying individuals, as ear print (Dhanda et al., 2011). Variations in ear morphology were assessed depending on its anatomical aspect that aimed mainly for identification of wrongdoer (Abbas and Rutty, 2005). The ear measurements vary according ethnic groups, which is important for treatment of auricular deformities and facial reconstruction procedures. Dimensions of auricle are so beneficial to plastic surgeon that needs normative data. In human, the ear composed of outer, middle and inner parts. External ear is formed by auricle and external acoustic meatus which is important in the forensic sciences for personal identification. Auricle was considered as a primary

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feature of the human face and is particularly important in appearance (Purkait and Singh 2007; Sinnatumby, 2011). Certain studies on human ears suggested that there were morphological variations, but these data lacked inter- ethnic groups parameters, and these variations are important for the forensic sciences in human identification (Kapil et al., 2014; Chattopadhyay and Bhatia, 2009).

Ear print final individualization depended on specific ear details, like site, size, creases patterns and helix features. Ear parameters were assessed and they developed the Forensic Ear Identification research project (Meijerman et al., 2004). Familial relationships could be evaluated depending on ear characteristics, as ear morphology seems to be hereditary (Imhofer, 1906). For instance, the ear is classified into four shapes, which are triangular, rounded, oval and rectangular (Dhanda et al., 2011). Ear have its importance to the physiognomy and aesthetics of the face. Furthermore, people with congenital malformations or trauma of the ear usually uncomfortable. Surgery is needed to treat auricular defects, plastic surgeons require information about normal auricular dimension, but these data is different in various ethnic groups (Akpa et al., 2013; Kumar and Selvi 2016; Sadler, 2019).

This study aims to assess the morphometry and biometrics of external ear auricle, and to compare variations among, genders, shape of auricle and lobule attachment status in Iraqi subjects.

## Subjects and methods

In this present longitudinal randomized study, a total of 311 pharmacy students were recruited for the study, having age 18-22years, at Al-Rafidain University College, Baghdad and approved by ethical committee in the university. All the subjects were normal healthy residents of Iraq, 157 male and 154 female, the study was conducted during the period of March 2018 to January 2019. The study purposes were explained to all subjects and a written informed consent was obtained from each subject. Medical history and clinical examination were obtained, none of those enrolled for the study have history of craniofacial trauma, ear diseases, congenital anomalies or surgery of the ear auricle (Verma et al., 2016). Measurements of parameters were obtained directly from both right and left ears by a single investigator (to eliminate error), by using a digital Vernier's caliper. Measurements were recorded in millimeter, to the nearest 0.1mm. Each subject measured twice for accuracy and to each dimension. Assessment of auricle shape and status of lobule either free or attached were evaluated by at two investigators and for both ears and once there was asymmetry, subject was excluded. Originally, the overall number of randomly selected students was 318; the number of excluded cases for different reasons was seven. The Anthropometric parameters that were measured includes the following anatomical landmarks (Kapil et al., 2014), and are illustrated in Figure 1:

1. Total Ear height: from highest to lowest point of Auricle.
2. Ear height above tragus: highest point of auricle to tragion.
3. Ear height below tragus: lowest point of auricle to intertragic incisures.
4. Tragus span: extends from intertragic incisure to tragion.
5. Width of Ear: distance from ear root to extreme helix convexity.
6. Concha length: from intertragic incisure to cymba concha.

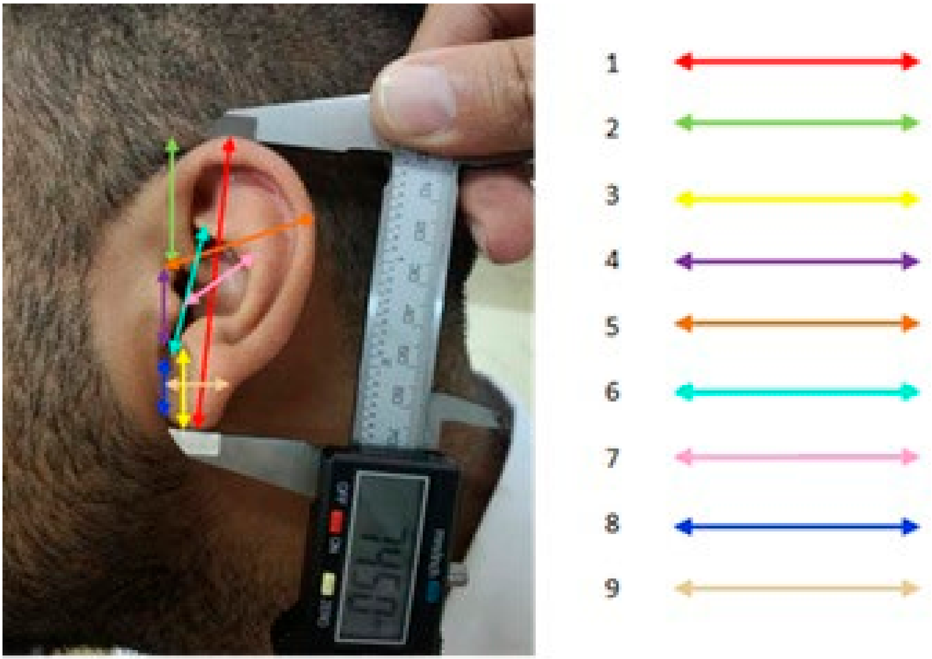


**Figure 1.** showing the recorded Anthropometric parameters of the auricle. Total Ear height (1), Ear height above tragus (2), Ear height below tragus (3), Tragus span (4), Width of Ear (5), Concha length (6), Concha width (7), Lobule height (8), Lobule width (9).

7. Concha width: extends from the antihelix concavity to tragus border.
8. Lobule height: from inferior site of the external ear attachment to the head (otobasion inferior) to the lower expansion to free margin of the ear lobe (subaurale).
9. Lobule width: from the most caudal attachment of the ear lobule to the head and to the outermost maximum transverse width of the ear lobule.

### Statistics

The collected data was statistically analyzed using SPSS software v.20. T test ,one way ANOVA followed by post hoc test, chi square Fisher Exact and Pearson correlation test were used to compare the differences of parameters with significance value $P<0.05$.

## Results

The measurements of nine parameters were assessed according to gender and lobule status (Free or Attached) and for both right and left ears and recorded in Table 1. Regarding gender, significant differences were noticed in the height above tragus, tragus span and lobule height. Conversely, no significances were seen in all parameters

**Table 1.** Ear morphometry for right (R) and left (L) ears (measurements in mm). The results were expressed as mean ±SD. significant difference for gender difference marked by * (P<0.05).

| Parameter | Gender | Mean ± SD | Lobule | Mean ± SD |
|---|---|---|---|---|
| Total Ear height R | Female N=154 | 52.2 ± 5.6 | Free (N=186) | 52.7 ± 6.7 |
| | Male N=157 | 53.3 ± 6.8 | Att (N=125) | 52.8 ± 5.5 |
| Total Ear height L | Female | 52.2 ± 5.7 | Free | 52.8 ± 6.8 |
| | Male | 53.4 ± 6.9 | Att | 52.9 ± 5.7 |
| Ear height above tragus R | Female | 46.7* ± 6.0 | Free | 47.7 ± 6.2 |
| | Male | 48.1 ± 5.7 | Att | 47.1 ± 5.4 |
| Ear height above tragus L | Female | 46.8* ± 6.0 | Free | 47.8 ± 6.1 |
| | Male | 48.3 ± 5.7 | Att | 47.2 ± 5.4 |
| Ear height below tragus R | Female | 32.0 ± 4.4 | Free | 32.3 ± 4.2 |
| | Male | 32.4 ± 3.8 | Att | 32.0 ± 4.0 |
| Ear height below tragus L | Female | 32.2 ± 4.4 | Free | 32.3 ± 4.7 |
| | Male | 32.0 ± 5.0 | Att | 31.8 ± 4.7 |
| Tragus span R | Female | 25.7* ± 4.1 | Free | 26.5 ± 4.4 |
| | Male | 26.9 ± 4.5 | Att | 26.1 ± 4.2 |
| Tragus span L | Female | 25.7* ± 4.6 | Free | 26.6 ± 4.5 |
| | Male | 27.0 ± 4.6 | Att | 26.0 ± 4.7 |
| Width of Ear R | Female | 33.0 ± 4.5 | Free | 33.5 ± 4.5 |
| | Male | 33.6 ± 4.3 | Att | 33.0 ± 4.2 |
| Width of Ear L | Female | 33.0 ± 4.4 | Free | 33.4 ± 4.4 |
| | Male | 33.5 ± 4.2 | Att | 33.1 ± 4.2 |
| Concha length R | Female | 20.5 ± 3.1 | Free | 20.8 ± 3.1 |
| | Male | 21.0 ± 3.0 | Att | 20.8 ± 3.1 |
| Concha length L | Female | 20.8 ± 3.0 | Free | 21.0 ± 3.0 |
| | Male | 21.2 ± 3.0 | Att | 20.9 ± 3.0 |
| Concha width R | Female | 32.6 ± 4.4 | Free | 33.2 ± 4.4 |
| | Male | 33.5 ± 4.4 | Att | 32.8 ± 4.3 |
| Concha width L | Female | 32.7 ± 4.4 | Free | 33.3 ± 4.4 |
| | Male | 33.6 ± 4.3 | Att | 33.0 ± 4.3 |
| Lobule height R | Female | 8.0* ± 2.1 | Free | 7.9 ± 1.9 |
| | Male | 7.6 ± 1.7 | Att | 7.7 ± 1.9 |
| Lobule height L | Female | 8.4* ± 1.9 | Free | 8.1 ± 1.8 |
| | Male | 7.8 ± 1.6 | Att | 7.9 ± 1.9 |
| Lobule width R | Female | 20.0 ± 3.3 | Free | 20.2 ± 3.4 |
| | Male | 20.3 ± 3.4 | Att | 20.0 ± 3.3 |
| Lobule width L | Female | 20.1 ± 3.1 | Free | 20.3 ± 3.0 |
| | Male | 20.3 ± 3.0 | Att | 20.0 ± 3.0 |

according to lobule status. All parameters in both right and left side and for different shapes showed significant differences by ANOVA test (Table 2). Therefore, Bonferroni post-hoc test was done to compare the mean differences in each shape with others (labeled by superscript a, b, c and d; Table 2) for significantly difference comparing oval, rectangular, round and triangular with each other when $P<0.05$ respectively. The percentages of female were higher in rectangular and then round in contrast to male that had higher percentage in oval and then triangular shapes (Table 3). High significant relationship was observed between shape of ear and gender of subject by using Chi square. Gender difference regarding lobule showed that 66% of male had free lobule compared to 54% of female with free lobule. An assessment of relation between lobule status and gender was done using Fisher Exact test and significant difference were found (Table 4). Pearson Correlations among various parameters showed positive and significance correlation in most of parameters (Table 5 and 6). Each of the following parameters (total ear height, height below tragus, tragus span, concha length and lobule width) showed significant correlation when compared to almost all other parameters.

**Table 2.** Ear morphometry for R and L according the shape of auricle. The results were expressed as mean ±SD. ANOVA test significance followed by Post hoc Bonferroni test which represented by a,b , c and d for significantly difference as compared to oval, round , rectangular and triangular respectively. Also lateralization significance (right and left) were demonstrated in total column and marked by * (P<0.05).

| Parameter | | Oval N=85 Mean ± SD | Round (N=47) Mean ± SD | Rectangular (N=68) Mean ± SD | Triangular (N=111) Mean ± SD | Total (N=311) Mean ± SD |
|---|---|---|---|---|---|---|
| Total Ear height | R | 50.0 ± 4.6 | 51.5$^{c}$ ± 7.5 | 57.2$^{abd}$ ± 6.6 | 52.6$^{ac}$ ± 5.0 | 52.8* ± 6.3 |
| | L | 50.0 ± 4.7 | 51.4$^{c}$ ± 7.5 | 57.4$^{abd}$ ± 6.7 | 52.8$^{ac}$ ± 5.2 | 52.8 ± 6.4 |
| Ear height above tragus | R | 45.9 ± 4.5 | 48.5 ± 5.9 | 50.3$^{ad}$ ± 7.4 | 46.4$^{c}$ ± 5.0 | 47.4* ± 5.9 |
| | L | 45.9 ± 4.4 | 48.7 ± 5.9 | 50.5$^{ad}$ ± 7.3 | 46.6$^{c}$ ± 5.1 | 47.6 ± 5.8 |
| Ear height below tragus | R | 30.1 ± 2.9 | 33.1$^{a}$ ± 4.2 | 34.9$^{ad}$ ± 5.0 | 31.7$^{ac}$ ± 3.2 | 32.2 ± 4.1 |
| | L | 30.2 ± 3.0 | 32.7$^{a}$ ± 5.9 | 35.0$^{ad}$ ± 5.0 | 31.5$^{c}$ ± 4.1 | 32.1 ± 4.7 |
| Tragus span | R | 23.5 ± 2.6 | 27.3$^{ac}$ ± 4.7 | 29.7$^{abd}$ ± 4.3 | 25.9$^{ac}$ ± 3.7 | 26.3 ± 4.3 |
| | L | 23.5 ± 3.6 | 27.4$^{ac}$ ± 4.8 | 29.9$^{abd}$ ± 4.4 | 26.0$^{ac}$ ± 3.7 | 26.4 ± 4.6 |
| Width of Ear | R | 30.6 ± 2.7 | 34.7$^{ad}$ ± 4.3 | 36.8$^{abd}$ ± 4.3 | 32.6$^{abc}$ ± 3.9 | 33.3 ± 4.4 |
| | L | 30.6 ± 2.7 | 34.5$^{a}$ ± 4.5 | 36.4$^{ad}$ ± 4.4 | 32.8$^{ac}$ ± 3.8 | 33.3 ± 4.3 |
| Concha length | R | 19.1 ± 2.3 | 21.5$^{a}$ ± 2.9 | 22.9$^{ac}$ ± 3.0 | 20.4$^{ac}$ ± 2.9 | 20.8* ± 3.1 |
| | L | 19.4 ± 2.5 | 21.7$^{a}$ ± 2.8 | 22.9$^{ad}$ ± 2.9 | 20.7$^{ac}$ ± 2.7 | 21.0 ± 3.0 |
| Concha width | R | 30.3 ± 2.4 | 34.3$^{acd}$ ± 4.9 | 36.8$^{abd}$ ± 4.2 | 32.3$^{abc}$ ± 3.7 | 33.0* ± 4.4 |
| | L | 30.6 ± 2.4 | 34.4$^{acd}$ ± 4.7 | 36.8$^{abd}$ ± 4.2 | 32.5$^{abc}$ ± 3.8 | 33.2 ± 4.4 |
| Lobule height | R | 7.1 ± 1.8 | 8.0$^{a}$ ± 1.4 | 8.2$^{a}$ ± 1.9 | 8.1$^{a}$ ± 2.1 | 7.8* ± 1.9 |
| | L | 7.3 ± 1.8 | 8.5$^{a}$ ± 1.3 | 8.3$^{a}$ ± 1.7 | 8.3$^{a}$ ± 1.8 | 8.1 ± 1.8 |
| Lobule width | R | 18.0 ± 2.4 | 21.1$^{a}$ ± 3.6 | 22.4$^{ad}$ ± 3.4 | 20.0$^{ac}$ ± 2.8 | 20.1 ± 3.4 |
| | L | 18.3 ± 2.1 | 20.9$^{ac}$ ± 3.5 | 22.3$^{abd}$ ± 3.1 | 20.0$^{ac}$ ± 2.5 | 20.2 ± 3.0 |

**Table 3.** Distribution of gender according to ear shape. Significant difference was calculated using Chi square**.**

| Gender | Shape | | | | Total |
|---|---|---|---|---|---|
| | Oval (100%) | Round (100%) | Rectangular (100%) | Triangular (100%) | |
| Female | 31(36%) | 25(53%) | 53(78%) | 45(41%) | 154 |
| Male | 54(64%) | 22(47%) | 15(22%) | 66(59%) | 157 |
| Total | 85(27.3%) | 47(15.1%) | 68(21.9%) | 111(35.7%) | 311 (100%) |
| The chi-square statistic showed P value < 0.00001 | | | | | |

**Table 4.** Relation between gender and lobule status using Fisher's Exact Test.

| Gender | Lobule | | Total |
|---|---|---|---|
| | Free | Attached | |
| Female | 83(54%) | 71(46%) | 154(100%) |
| Male | 103(66%) | 54(43%) | 157(100%) |
| Total | 186 | 125 | 311 |
| Fisher's Exact Test showed P value < 0.05 | | | |

**Table 5.** Pearson correlation for different parameters of right ear. significant difference marked by ** (P<0.05).

| Pearson Correlation | Total ear height | Height above tragus | Height below tragus | Tragus span | Width of ear | Con-cha length | Con-cha width | Lobule height | Lobule width |
|---|---|---|---|---|---|---|---|---|---|
| Total ear height | 1.00 | .67** | .35** | .60** | .50** | .34** | .58** | .13 | .45** |
| Height above tragus | .67** | 1.00 | .34** | .52** | .46** | .33** | .53** | .10 | .41** |
| Height below tragus | .35** | .34** | 1.00 | .62** | .53** | .74** | .69** | .13 | .76** |
| Tragus span | .60** | .52** | .62** | 1.00 | .70** | .61** | .85** | .18** | .71** |
| Width of ear | .50** | .46** | .53** | .70** | 1.00 | .62** | .79** | .07 | .68** |
| Concha length | .34** | .33** | .74** | .61** | .62** | 1.00 | .72** | .13 | .85** |
| Concha width | .58** | .53** | .69** | .85** | .79** | .72** | 1.00 | .11 | .81** |
| Lobule height | .13 | .10 | .13 | .18 | .07 | .13 | .11 | 1.00 | .16 |
| Lobule width | .45** | .41** | .76** | .71** | .68** | .85** | .81** | .16 | 1.00 |

## Discussion

The ear is an important part of the human face, functionally as well as esthetically. There is a wide range of normal variation in the shape of the external ear among populations. To strengthen the scientific basis for ear variations for identification, we

**Table 6.** Pearson correlation for different parameters of left ear. significant difference marked by ** (P<0.05).

| Pearson Correlation | Total ear height | Height above tragus | Height below tragus | Tragus span | Width of ear | Concha length | Concha width | Lobule height | Lobule width |
|---|---|---|---|---|---|---|---|---|---|
| Total ear height | 1.00 | .67** | .30** | .57** | .55** | .32** | .58** | .10 | .48** |
| Height above tragus | .67** | 1.00 | .30** | .51** | .52** | .32** | .53** | .07 | .42** |
| Height below tragus | .30** | .30** | 1.00 | .50** | .56** | .61** | .57** | .13 | .66** |
| Tragus span | .57** | .51** | .50** | 1.00 | .74** | .57** | .80** | .14 | .68** |
| Width of ear | .55** | .52** | .56** | .74** | 1.00 | .71** | .88** | .10 | .81** |
| Concha length | .32** | .32** | .61** | .57** | .71** | 1.00 | .68** | .15 | .80** |
| Concha width | .58** | .53** | .57** | .80** | .88** | .68** | 1.00 | .11 | .79** |
| Lobule height | .10 | .07 | .13 | .14 | .10 | .15 | .11 | 1.00 | .16 |
| Lobule width | .48** | .42** | .66** | .68** | .81** | .80** | .79** | .16 | 1.00 |

must understand more about how to select and use ear morphological features and know more about the factors that determine the range of racial variation. The Knowledge about the normal human ear dimensions and morphological features of various populations can be helpful from anthropological and forensic point of view to provide data procedures for the inclusion and exclusion of persons for identification based on ear variations (Verma et al., 2016). Furthermore, the data obtained from ear morphometric studies among populations will provide bases for ear reconstruction for plastic surgeons. Consequently, due to the complexity of the external ear, different anatomical landmarks of the external ear have been recorded in this study and in other various studies. Human ear shapes and variations can be useful for identification in the absence of fingerprints and facial recognition adopted software (Perpinan 1995; Asai et al., 1996; Sforza et al., 2009; Kalra et al., 2015; Verma et al., 2016; Japatti 2018). Age related changes showed a progressive increase of ear dimensions with age (Sforza et al., 2009). However, age related dimensional changes were not identical for all ear parameters (Japatti, 2018). Childhood and adolescent growth patterns were faster than those reported after adulthood. It is well accepted that the mature height of ear in males occurs at 13 year of age and in females at 12 years (Kalra et al., 2015). It has been stated that beyond 20 years of age, any size increase was basically attributable to secondary elongation of the earlobes due to gravitational forces (Verma et al., 2016). Therefore, all the subjects recruited in this study were mature males and females above external ear maturity age and less than 22 years old. All measurements were obtained directly from subjects, as it is the ideal anthropometry technique, although, indirect anthropometric techniques such as photography are also frequently used. Additionally, to eliminate inter-observer error, this is higher than intra-observer error (Petrescu et al., 2018). The entire sets of measurements were done by a single investigator, who has expertise in anthropometric measurements.

In the last few years, ear dimensions have been investigated in various ethnic groups, using direct as well as indirect anthropometry and photography (Japatti 2018). Indian ear biometric studies showed clear variations among the different ethnicity of the population (Kapil et al., 2014; Verma et al., 2016). Indian male parameters by Kapil et al. (2014) showed higher values in ear height, ear width, concha length and lobule height and lower values in the remaining parameters in comparison with the male Iraqi results obtained above. For example, the total ear height mean among male Indians was 64.2 mm, which is higher than the Iraqi males (53.4 ± 6.9 mm). These differences might be related to smaller sample size in their study (n=100), and in addition to race variation. Moreover they found that subjects with free lobule (65.14%) and (34.85%) for attached lobule in contrast to our study that revealed free lobule (59.8%) and (40.2%). Furthermore, another Indian ear biometric study by Kalra et al., (2015) showed the ear total height 57.7mm, which is also higher than our obtained data. However, ear width of male in our results was 33.6 mm, proximate to Indian study Purkait (2007) and lower than that of another Indian study (Kapil et al., 2014). On the other hand, Osunwoke et al., (2018) found that Nigerian subjects had total ear height 54.3 ± 4.120 and the width of ear was 31.4 ± 2.5mm. These findings are also higher than our obtained results for total ear height and lower for width of ear, 52.8 ± 6.3 and 33.3 ± 4.8, respectively. In their study, another difference regarding the auricle shape, which was lowest percentage of triangular shape among Nigerians in contrast to our sample that showed highest percentage of triangular shape. They also claimed that no significant difference between ear shape and gender, which disagreed with our findings that showed a significant difference between gender and lobule shape. Additionally, they stated that right ear parameters are larger than left ear parameters, which is inconsistence with ours, as we found most of the parameters are higher in the left than in the right, although a few records showed proximity of both sides, and a few measurements showed higher in the right (Table 2). These findings could be explained by the use of more number of variables in our study, as we used nine, compared to only two variable used in their study.

Comparing total ear height and width of ear among Iraqi population with other populations from different countries, the total ear height values of Iraqis' appear the smallest of all. However, the width of ear is among the smallest of all obtained data. Irrespective of the ethnicity of the study population, male showed higher values of both ear height and width compared to females (Ito et al., 2001; Azaria et al., 2003; Brucker et al., 2003; Bozkir et al., 2006; Sharma et al., 2007; Murgod et al., 2013; Purkait and Singh 2014). In our results, males were found to have marginally longer and wider ears as compared to females. Further gender comparison in our data demonstrates that males have slightly higher values in all parameters compared to females, excluding the lobule height which is higher in females. These results agreed partly with Murgod et al., (2014) which stated that lobe width and height were higher in females. Moreover, another study by Kalra et al., (2015) showed that total ear height and lobule height had higher values than our results but ear width and lobule width had lower values than ours and for both males and females. Although, our findings did not show any significance difference between genders regarding ear height and width, however lobule height showed a significance in both right and left side between males and females. Various previous studies have reported ear symmetry with different findings (Azaria et al., 2003; Sforza et al., 2009; Alexander et al., 2010). Comparing the parameters between right and left ear, our data showed no significant difference between both sides, which support symmetry between right and left ears. However, in several studies significant asymmetry was noted in total ear height and width ( Barut et al., 2006; Murgod et al., 2013). On the other hand, Petrescu et al., (2018) suggested that the shape of the ear is mainly determined by the proportions of its different dimensions, less than their absolute values and claimed that concha width and concha length had positive correlation with ear width and height respectively. In addition, they noted that of the 28 possible correlations between dimensional parameters of the ear only three parameters in the right ear and four in the left ear are significant. In contrast, our findings revealed many correlations in both right and left ears among various parameters (Table 5 and 6), particularly width of ear and concha width as they have significant and highly positive correlation with almost all parameters (Pearson correlation value is more than 0.5). These correlations could be useful in reconstructive plastic surgery, by measuring a group of parameters and estimate the remaining parameters. Additionally, Acar et al., (2017) who studied Turkish and African sample found a significant difference according to lateralization in ear lengths of Turkish male and African female individuals. In contrast to our results that found ear length in both male and female had significant difference according to lateralization. The ear classified by Dhanda et al., (2011) into four shapes triangular, rounded, oval and rectangular. Verma et al., (2016) stated that most common shape of north India was oval shape in contrast to round that had lowest percentage. These findings disagree with ours, as highest percentage was the triangular shape and agreed with lowest percentage that was the round in the total subjects. However, the highest proportion among males was the triangular, and among females was the rectangular. On the other hand, ear lobule attachment was found to be an interesting indicator in population genetics (Bhasin, 1969). In present study our population showed more percentage of free ear lobe among both males and females. These results were in accordance with Kapil et al., (2014) and contrary to others (Sharma et al., 2007; Verma et al., 2016). These differences might be attributed to different ethnic and genetic backgrounds of study populations.

In conclusion, throughout this study, different anatomical variations were observed in all subjects and in different parameters that can be used for personal identification especially for forensic and reconstruction purposes. According to our knowledge no previous study was done in Iraq to standardize ear parameters and assess the percentage of different auricle shapes. Consequently, we think that the information obtained are important for providing valid and objective reference of ear morphometry among the study subjects in Iraq. Nevertheless, we believe that an extensive larger sample, including different regions, should be examined in detail to further validate the findings of this study and come to definitive conclusions over Iraqis.

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## Conflict of interest

The authors declare no conflict of interest

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