Short Communication

Application of external ear morphometry in age prediction: a pilot study

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ABSTRACT

Background: Information about age and sex that is obviously difficult to characterize can be derived from the shape of the ear which is an important but under-utilized defining feature of the head. The study aims at investigating the correlation between age and ear length, width and index for both left and right sides. The regression equation in estimation of age was formulated.

Methods: A total of 219 subjects consisting of 137 males and 82 females were recruited among Bayero University students for the study. Ear length and width were measured using calibrated transparent ruler. Ear index was calculated as ear width/ ear length ×100. Pearson correlation was used to establish the relationship between age and external ear variables. The data was analysed using SPSS version 16 and $P < 0.05$ considered as level of significance.

Results: The result shows positive higher correlation in left ear length ($r = 0.24$, $P < 0.001$) and the least was found in left ear index ($r = 0.002$, $P > 0.05$).

Conclusions: A linear equation model for estimation of age from given ear dimension was developed. Ear morphometry can serve as an additional tool in the estimation of age of unknown individual.

Keywords: Age, External ear, Hausas, Morphometry, Regression

INTRODUCTION

Information about age and sex that is obviously difficult to characterize can be derived from the shape of the ear which is an important but under-utilized defining feature of the head.[1] Studies on the age-related variations in ear linear dimensions during growth, development and ageing was reported in some ethnic group especial Caucasian; Dutch,[2] German,[3] Italian,[4-6] European,[7] North American,[1,8] Turkish.[9-11] Other population include Indian,[12-14] Ashkenazi and Sephardi Jew,[15] Japanese,[16] Nigeria.[17]

Anomalies of the ear including missing external ear, prominent ears, and microtia may be as a result of various causes such as trauma, surgical resection, tumours, or congenital deformities.[18] Abnormality of external ear is an indication of presence of possible anomaly in the subject. In normal subject the ear is play vital role as

component of the head complex, which may give insight about the age and sex of individual. Its location, size and shape on the head are also useful from an aesthetic point of view.[19] There is paucity of information regarding the prediction of age from external ear morphometry in our community. The prediction of age for unknown individuals can always serve as adjunct among other related information in revealing the identity of unknown individuals or unconscious patients. The study aims at investigating the correlation between age and ear length, width and index for both left and right sides. A regression equation for estimation of age was also developed.

METHODS

A total of 219 subjects consisting of 137 males and 82 females were recruited among Bayero University students for the study. After written informed consent any subject

with physical deformity in the external ear was excluded from the study.

The ear length was measured as the distance from the caudal most projection of the lobule to the cephalic most projection of the helix. Ear width was measured as distance between the most anterior and posterior point of the external ear.[1,17] Ear index was calculated as ear width/ ear length ×100.[20] The length and width anthropometry were taken using calibrated transparent ruler (in mm). For accuracy repeated measurement method was employed and average values were recorded. The age of the participants was obtained from self-reported date of birth using questionnaire.

The data were expressed as mean ± standard deviation. The Pearson correlation was used to establish the relationship between age and external ear variables. The data were analysed using SSPS version 20 statistical software and P < 0.05 was considered as level of significance.
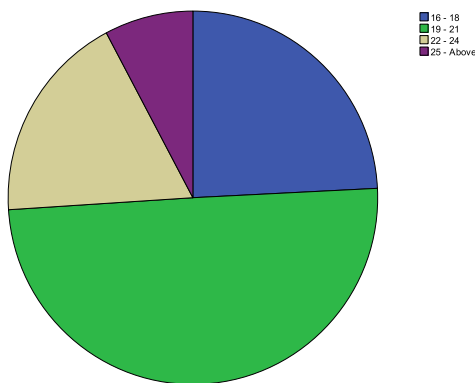
RESULTS

The descriptive statistics show the nature of the study population with mean age of 20.41± 2.94 years. In all variables, right ear shows higher mean values and the higher value of standard deviations were also obtained in the right side of the body (Table 1).

Table 1: General parameters of the study population (n =219).

Parameters	Mean	SEM	SD	Range	Min	Max	Variance
Age (years)	20.41	0.20	2.94	24.00	16.00	40.00	8.67
REL (mm)	60.31	0.27	3.93	20.00	50.00	70.00	15.47
LEL (mm)	59.95	0.25	3.66	20.00	50.00	70.00	13.37
REW (mm)	30.46	0.17	2.52	15.00	23.00	38.00	6.36
LEW (mm)	29.54	0.16	2.33	12.00	24.00	36.00	5.41
REI	50.59	0.27	3.94	23.79	40.00	63.79	15.55
LEI	49.36	0.25	3.69	24.04	37.50	61.54	13.60

REL; Right ear length, LEL; Left ear length, REW; Right ear width, LEW; Left ear width, REI; Right ear index, LEI; Left ear index, SEM; Standard error of mean, SD; Standard deviation

The age distribution of the participants showed that majority of the population belongs to 18 to 22 years of ages. The less frequent age range was from 16-17 and 24 – 40 years of age (Figure 1).

For establishment of correlation, the scatter plot of was used to demonstrate of Age and the six variables considered in the study (Figures 2-7).

Table 2: Correlation matrix of the variables of ear dimensions.

	REL	LEL	REW	LEW	REI	LEI
Age	0.207**	0.244**	0.229**	0.190**	0.066	0.002
P Value	.002	.000	.001	.005	.332	.977

** Correlation is significant at the 0.01 level (2-tailed).
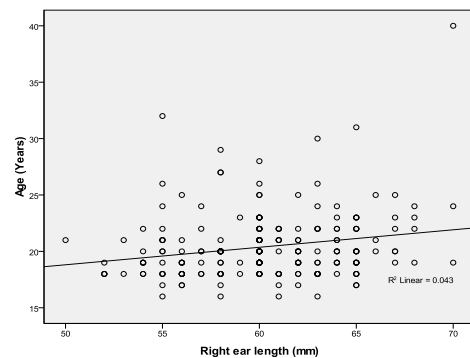

Figure 1: Age distribution of the study population.

A higher positive correlation was observed between left ear length and age (r=0.244) and the least was found in left ear index (r=0.002). The correlation is statistically significant (p<0.000) in all the variables with exception of REI (p=0.332) and LEI (p=0.977) (Table 2).

Figure 2: Correlation between age and right ear length.

The regression formulae for estimation of the age (years) for six ear variables is shown in Table 3.
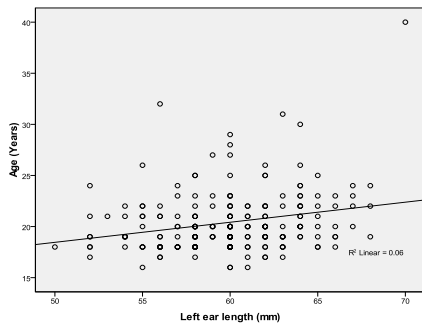

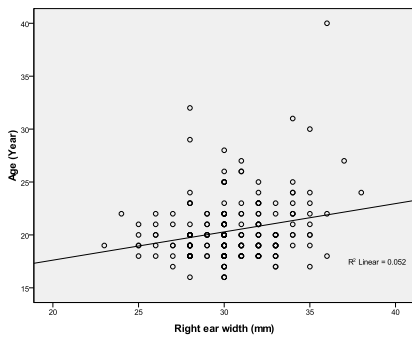**Figure 3: Correlation between age and left ear length.**

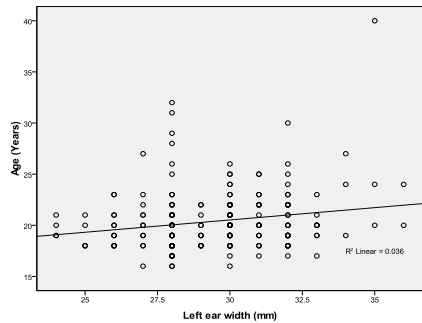**Figure 4: Correlation between age and right ear width.**

Figure 5: Correlation between age and left ear width.
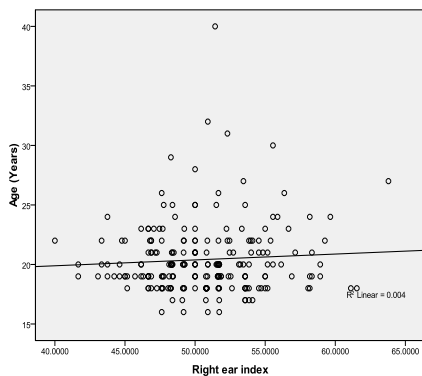

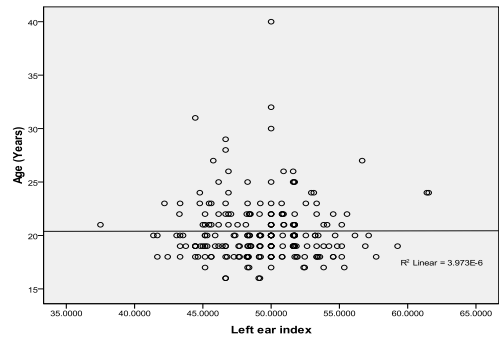**Figure 6: Correlation between age and right ear index.**

Figure 7: Correlation between age and left ear index.

Table 3: Regression models of age prediction from ear dimensions.

Models	Adj. R^2	S.E.E	t	P
Age = 0.155 (REL) + 11.058	0.039	2.886	3.681	<0.001
Age = 0.196 (LEL) + 8.634	0.055	2.861	2.712	0.007
Age = 0.267 (REW) + 12. 271	0.048	2.872	5.205	<0.001
Age = 0.241(LEW) + 13.300	0.032	2.897	5.323	<0.001
Age = 0.049 (REI) + 17.922	0.000	2.944	6.985	<0.001
Age = 0.002 (LEI) + 20.332	-0.005	2.950	7.582	<0.001

DISCUSSIONS

Previously external ear parameters were studied for the surgical treatment of congenital deformities and reconstruction, but now a day it gives information on age and sex, hence plays a significant role in medical and forensic investigation.[21] The present study presents the application of external ear morphometry in prediction of age of individual. The result of the study shows significant correlation (p < 0.05) in all the parameters considered with the exception of the ear index. To estimate the age from ear linear dimensions regression model was generated. This may provide some form of reliable and scientific mean of knowing the age of an individual in the hospital setting or elsewhere for proper intervention.

The present result is in agreement with the study of Ito et al.,[16] who reported that the external ear morphometric measurements can be used for estimation of age and sex of an individual. It also shown that after completion of development at teenage, the size of the human auricle increases and finally concluded that age associated changes appear to continue during adulthood.[16] In another study of anthropometry of the normal human auricle carried out on 415 adult Indian male subjects, it was shown that all the linear measurements increase steadily in size with age.[19] Morphometric study of the human ear on three different

populations of 420 participants demonstrated ethnic variation as well as age related changes.[22] According to Sharma et al.[13] there was an increase in linear ear dimensions with age in the study conducted on 80 individuals of age range 1 to 20 years. The report for age related changes in ear length shows significant increases as age advances.[17] This indicates that morphometry of the ear increases proportionally with age.

Many of the anthropological variables were sensitive to ethnicity. In the study we considered the Hausa ethnic group as a target population. The model for estimation of the age of Hausa ethnic group from external ear morphometry was generated. This can give room for proper intervention in a situation where the age has been consider as one of the priority. As it's well known to be the practice of the some of the poor resources community that the actual age of an individual especially the adults is a matter of guessing. Therefore, in this regards the use of the generated formula which is specific to particular ethnic group can be of help.

Some source of error that may occur in the study may be linked to method adopted in age recording of the participant. This involves self-report of the date of birth. The level of accuracy of the formulae may be increased by deriving separate formulae for males and females as well as for different age groups. This should be the aim of the further research on the same topic in order to perfect the formulae for estimation of age from external ear morphometry.

In conclusion, the study proved the application of external ear morphometry in the estimation of age of individual. Hence, External ear linear dimensions can serve as additional tool for age estimation of individuals.

ACKNOWLEDGEMENTS

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