A STUDY OF GENETIC INHERITANCE PATTERN OF THE EAR LOBULE ATTACHMENT IN SELECTIVE SAMPLE OF RAJASTHAN STATE

[1]Mandeep Kaur, [2]Navjot Kaur, [3]Parveen Sharma

[1]Ph.D Research Scholar, Department of Anatomy, Adesh Institute of Medical Sciences, Adesh University, Bathinda (Pb.)

[2]Associate Professor, Department of Anatomy, Adesh Institute of Medical Sciences, Bathinda

[3]Professor, Department of Anatomy, Maharaja Ganga Singh Dental College, Sri Ganaganagar.

Corresponding Author:

Mandeep Kaur, Ph.D Research Scholar, Department of Anatomy, Adesh Institute of Medical Sciences, Adesh University, Bathinda (Pb.) India. Email mandeep.brar159@gmail.com, Contact No. +91 9610520030

Abstract

Introduction: The earlobe is formed by tough areola and adipose tissue, lacking the firmness and elasticity of the rest of the ear auricle. The study of earlobe attachment, as a morphogenetic trait can be used to investigate the diversity that arises within and among different populations due to genetic variations

Materials and Methods: The present longitudinal randomized study was carried on randomly selected 100 families, residing in Sriganganagar Rajasthan. Digital camera, USB Cable and laptop were used for the study.

Results: Out of total 158 offspring 86.08% are free and 13.92% are attached. Males and females displayed the highest frequency of free earlobes. There is no significant gender difference in the pattern of earlobe attachment.

Conclusion: The free earlobe is more predominant than attached earlobe and this study investigated an inheritance pattern of simple dominance recessive pattern where free earlobes are dominant over attached earlobes.

Key Words: Free earlobes, attached earlobes, human ear, trait, frequency.

Introduction

There are several morphological and metric features of human body have been used in the past for personal identification in forensic examination. Fingerprinting, DNA fingerprinting, footprints, facial features, Iris, gait, teeth, bite marks, lip prints from a variety of tissues of humans are utilized in forensic medicine. Like fingerprints, human ear is also unique to an individual, due to variations in the anatomical structure of the external ear (Iannarelli 1989).

The earlobe is formed by tough areola and adipose tissue, lacking the firmness and elasticity of the rest of the ear auricle (Keith and Arthur 2006). The earlobe is either directly attached to the lateral side of the face or hanging freely and therefore attached type of earlobe is slightly smaller than the free earlobe. This variation in the earlobe attachment may be a trait that is genetically inherited from parents and this inheritance follows a pattern (Ordu et al. 2014). The ear lobe attachment is referred to the way the base of the ear is attached to the upper part. Free and attached earlobe with a horizontal attachment to the lateral side of the face (Lai and Walsh 1966). In one article it is acknowledged that earlobe attachment is genetically determined and is usually presented as an example of a readily observable Mendelian phenotype in the educational materials and continues to be studied as Mendelian phenotype contemporary primary literature (Shaffer et al., 2017). The study of earlobe attachment, as a morphogenetic trait can be used to investigate the diversity that arises within and among different populations due to genetic variations (Chadha and Sandhu, 2013). It can be useful in settling parental dispute when they arise by understanding inheritance pattern of trait helps genetics to predict the probability of an offspring inheriting certain traits from parents (Hugo et al.,2003). In Indian population , inter population relationship and variations between populations have been studied (Kalia and Gupta 1978; Jadav et al.,2000). In this study, therefore the variability of earlobe attachment and its inheritance pattern will be investigated.

Materials and Methods

The present longitudinal randomized study was carried on randomly selected 100 families, residing in Sriganganagar Rajasthan. Digital camera, USB Cable and laptop were used for the study. Subjects were required to sit down with the head positioned in Frankfurt horizontal plane, namely a horizontal line connecting both inferior orbitale and tragion. Lateral surface of the ear was photographed in such a way that mid-vertical grid line of the camera aligned to pass through the mid-saggital plane of the face while the mid-horizontal pass through the Frankfurt horizontal plane. Subjects having history of craniofacial trauma, ear diseases, congenital abnormalities, females with large ear piercing hole and surgery of ear were excluded from the study. Pictures were arranged according to families and analysed. Chi-test was used to test pattern of inheritance based on Mendellian pattern of inheritance at 0.05 significant.

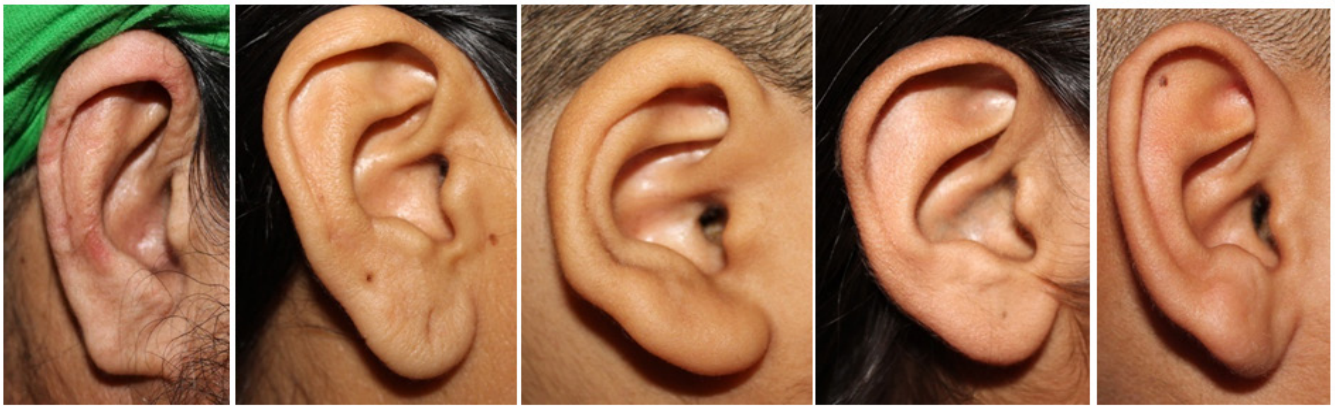
Results

358 individuals consisting of 158 children and 200 parents from 100 families were included in the study. These were grouped into 6 categories as represented by pictures below. These 6 families represent the 100 families participated in the study. All the families fall into any of the prototype 6 families. In picture 1, all the children (1 male and 1 female) and parents have free earlobe. Picture 2 has all children (2 male 1 female) and mother with free earlobe and father with attached earlobe while mother has attached earlobe with son and father having detached earlobe in picture 3. Both parents and children in picture 4 are all attached as compared to picture 5 where father and child are attached while mother is having free earlobe. Picture 6 shows that mother and child 1have attached while father and child 2 have free earlobe

All the offspring were grouped into attached and free earlobes as represented in table I and table II. Table I showed that if parental combination is free earlobe out off 80 offspring, 76 are having free while 4 are having attached earlobe. If parental combination is father free and mother attached out off 33 offspring, 28 are having free while 5 are having attached earlobe. If parental combination is mother free and father attached out off 31 offspring, 28 are having free while 3 are having attached earlobe. If both parents are having attached earlobe, out off 14 offspring 4 are having free, while 10 are having attached earlobe. The significance of observed frequencies are tested by chi-test at $p<0.05$ (critical value=3.84; and degree of freedom=9) as shown in table I that all the values are significant.

Picture 1: Pictures of family where both parents and children have free earlobe

Picture 2: Pictures of family where mother and all the children have free while father has attached earlobe



Picture 3: Picture of the family where child and father have free earlobe while mother have attached earlobe

FATHER MOTHER CHILD 1 F CHILD 2 M

Picture: 4 picture of the family where all family members have attached earlobe

FATHER MOTHER CHILD1 M

Picture: 5 Picture of the family where father and child have attached while mother have free earlobe

FATHER MOTHER CHILD 1 F CHILD 2 M

Picture: 6 Picture of the family mother and child 1have attached while father and child 2 have free earlobe.
All these can be represented using a Mendellian monohybrid cross on assumption that free earlobe is dominant (E) and attached earlobe recessive (e) allele

Father→	E	E
	EE	EE

Mother→	E	e
	Ee	Ee

Figure 1: Both parents are with free earlobe; one homozygous and another heterozygous. Expected offspring ratio is 1:0 (free:attached), all offspring will have free earlobe

Father→	E	e
Mother→	E	e
	EE	Ee
	Ee	Ee

Figure 2: Both parents are with free earlobe; heterozygous. Expected offspring ratio is 3:1 (free:attached), 75% of offspring will have free earlobe while 25% will have attached earlobe.

Father→	E	E
Mother→	e	e
	Ee	Ee
	Ee	Ee

Figure 3: one of parent is with free earlobe (homozygous) and another attached homozygous. Expected offspring ratio is 1:0 (free:attached), all offspring will have free earlobe.

Father→	E	e
Mother→	e	e
	Ee	Ee
	Ee	Ee

Figure 4: one of parent is with free earlobe (heterozygous) and another attached homozygous. Expected offspring ratio is 1:1 (free:attached), 50% offspring will have free earlobe while 50% will have attached earlobe.

Father→	e	e
Mother→	e	e
Ee	Ee	
Ee	Ee	

Figure 5: Both parents is attached (homozygous). Expected offspring ratio is 0:1 (free:attached), All offspring will have attached earlobe.

Parental combination Earlobe Attachment	Total no of offspring			No of male offspring		No of female offspring		Cal Chi-value	Critical value	Inference
	total	free	Attached	free	attached	free	attached			
Father free Mother attached	33	28	5	17	3	11	2	46.19	3.84	Significant
Mother free Father attached	31	28	3	15	2	13	1			
Both parents free	80	76	4	41	1	35	3			
Both parents attached	14	4	10	2	6	2	4			
Total	158	136	22	75	12	61	10			

Table I: Frequency table showing offspring with free and attached earlobe

Earlobe attachment	Total no offspring	No of male offspring	No of female offspring	Total %	Chi- value	P- value
Free	136	75	61	86.08	0.002	0.958
Attached	22	12	10	13.92		
Total	158	87	71	100.00		

Table II: Frequency table showing the total number of offspring

Table II showed that out of total 158 offspring 86.08% are free and 13.92% are attached. Males and females displayed the highest frequency of free earlobes. There is no significant gender difference in the pattern of earlobe attachment (df=1, chi-value=0.002, p-value=0.958)

Discussion

Our study suggested familial and gender pattern of earlobe traits and determine the pattern of earlobe attachment among the people of Sriganganagar District of Rajasthan state. This study revealed that the frequency of free earlobe (136, 86.08%) was above that of the attached earlobe (22, 13.92%) and this finding is in agreement with the report from Yadav et al., (2000) which stated that regularity of free earlobe as a range 56% to 74%in ethnic factions of Haryana. One investigation of ear lobe attachment done by Singh and Sengupta on the Indians remarked that the rate of recur-

rence of free earlobe (83.65%) is greater than that of attached (16.35%). The present study is not in accord with Pradhuman et al., (2016) who demonstrated that attached earlobe is more prevalent than free earlobe (35% free and 65% attached) among North East and North West subpopulation of India.

This study showed that male and female both have more of free earlobe, though the gender variation was insignificant which is in concordance with Anibor (2016) who stated that there is no significant gender difference in earlobe attachment.

Seventy six (55.88%) offspring had free earlobe and 4 (18.18%) had attached ear lobe when both parents had detached (fig-1, table I, picture 1). It is highly significant at $p<.05$ with high ratio because the parents who had free earlobe might be homozygous (EE) or heterozygous (Ee) in their genetic constitution (Nussbaum et al 2007). Fifty six offspring (35.17%) had either parent with free earlobe as shown in table-1, fig 3,4 and picture 2,3,5,6. These agree with the crosses above. Only 4 offspring (2.5%) had free earlobe when both parents had attached earlobe. This variation might suggest polygenic inheritance. Variations the earlobe attachments are due to the differences in the ages of offspring as there is increase in the earlobe length with increase with the age (Anshu et al., 2007). It was observed that the earlobe inheritance by offspring was independent of sexual difference. The genetic endowment is not sex linked or mitochondrial inheritance rather controlled by autosomal genes which are recessive for attached and dominant for free earlobe. This is in correspond with when he Rhodes Islands Red and Leghorns (Hays, 1943)

Conclusion

The free earlobe is more predominant than attached earlobe and there is no significant gender variation in the pattern of earlobe attachment. This study investigated the genetic endowment of earlobe attachment amongst the general population of Sriganganagar District of Rajasthan state revealed an inheritance pattern of simple dominance recessive pattern where free earlobes are dominant over attached earlobes.

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