



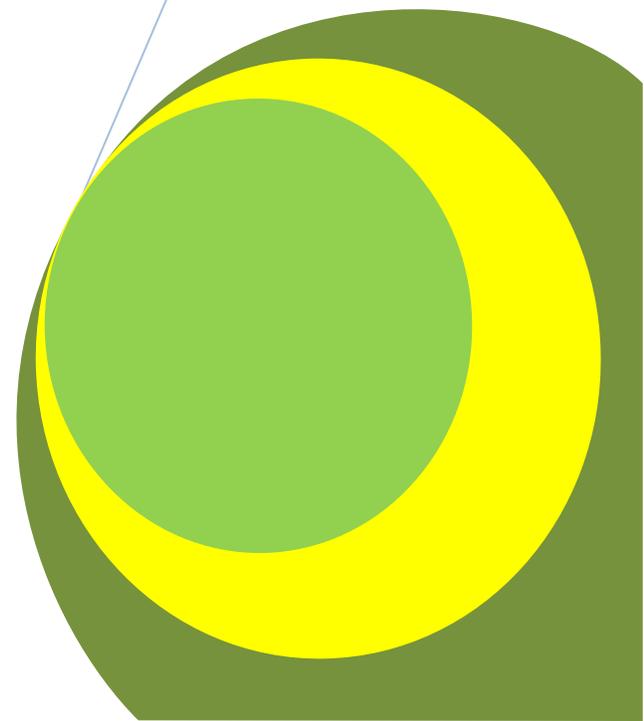
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Research Article

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ABSTRACT

Study on inheritance pattern of earlobe attachment in populations is scanty and reported to be unclear in populations where attempts have been made. In this study however, the inheritance pattern of earlobe attachment in a Nigerian population was investigated using 760 Nigerians from 200 families with 400 parents and 360 offspring within the ages of 5months-60years. Photographs of earlobe attachment of the subjects were taken and observed according to respective families. The result was analysed using Chi-test to test the pattern of inheritance based on Mendelian fashion at 0.05 significant. The inheritance pattern of earlobe attachment amongst Nigerian was found to follow a simple dominant-recessive pattern with the detached dominant over the attached earlobe and do not differ among the tribes with no significant difference in gender distribution of the trait in the population. The Results obtained suggest that observation of pattern of earlobe attachment trait might be suitable for genetic analysis and can help in settling paternal dispute.

Keywords: Inheritance Pattern, Earlobe Attachment, Nigerians.

INTRODUCTION

Earlobe also known as lobules auricular is the soft fleshy lower part found at the base of the external ear. It is the only part of the auricle not supported by cartilage (Richard et al., 2005). It is composed of the tough areola and adipose (fatty) connective tissues lacking the firmness and elasticity of the rest of the pinna (Chummy, 1999; Keith and Arthur, 2006). Earlobes average about 2cm long and elongate slightly with age (Anshu et al., 2007; Anadi et al., 2007). It is either directly attached to the lateral side of head (www.earlobe.org) or detached hanging freely away from the lateral side of head. The detached type is slightly bigger than the attached earlobe (Azaria et al., 2003). This variation in attachment of earlobe is a trait that is inherited from parents and its inheritance follows a pattern.

Inheritance is the process of transmitting biological traits from parents to offspring through genes, the basic unit of heredity (University of Utah Genetics Learning Center animated tour of the basics of genetics). The genetic constitution of organism is manifested phenotypically as observable trait like the earlobe attachment thereby classifying it as a morphogenetic trait.

The pattern of inheritance describes how allele work together to produce traits. Understanding inheritance patterns enables geneticists to predict the probability of an offspring inheriting certain traits from parents (Hugo et al., 2003). The patterns of inheritance described includes; Dominant-Recessive, Polygenic, X-Y Linked and Mitochondrial inheritance. Dominant-recessive inheritance involves 2 pairs of contrasting characters (allele) controlling one trait where one of the allele (recessive) is masked by another allele (dominant) when they occur together. The recessive can only manifest in homogenous form (Molly et al., 2010). In Polygenic inheritance a trait is controlled by multiple gene pairs. So there is a gradual variation of the trait in the population without a clear distinction. Examples include height, color etc. X-Y linked inheritance results when the gene is located in the sex chromosome (X or Y). Mitochondrial inheritance is when the chromosome is located in the mitochondrial of the cell instead of the nucleus like in the egg cells of humans (Nussbaum et al., 2007).

As a morphogenetic trait, the study of earlobe attachment can be used to investigate the diversity that arises within and among different populations due to genetic variations (Chadha and Sandhu, 2013). Understanding inheritance pattern of trait helps genetics to predict the probability of an offspring inheriting certain traits from parents (Hugo et al., 2003), therefore can be useful in settling paternal dispute when they arise. Inter population relationship and variations between populations have been studied in Indian populations (Kalia and Gupta 1978; Jadav et al., 2000). In this study therefore the variability of earlobe attachment amongst Nigerian populations and its inheritance pattern will be investigated.

MATERIALS AND METHODS

Digital camera, Bluetooth link and USB cord cable, and computer were used for the study. In obtaining the digital picture of the subjects, the head is held in stable anatomical position then hairs covering the ear are shifted away. The picture of the lateral side of the head is taken with a digital camera, starting with the children, then the mother and finally the father. Those that have torn ear lobes, fire burnt or gunshot ear lobes and earlobe creases were excluded. Having collected the pictures with the digital camera, they were transferred into the computer through USB cord for configuration and printing. These are arranged according to families and analyzed. Chi-test was used to test pattern of inheritance based on Mendellian fashion of inheritance at 0.05 significant.

RESULTS

760 Nigerians consisting of 360 children and 400 parents from 200 families were used. These were grouped into 7 categories as represented by the pictures below. These 7 families represent the 200 families used in the study. All the families fall into any of the prototype 7 families. In picture 1, both parents and all the children (2 females and 1 male) are detached. Picture II has all the children (2 females and 1 male) and father with detached earlobe and mother with attached earlobe while father has attached earlobe with mother and daughter having detached earlobe in picture III. Both parents and two daughters in picture IV are all attached as compared to picture V where father and child 2 are attached with mother and child 1 are detached. Picture VI presents a situation where mother and all three male children are detached while father is attached. In picture VII two out of the three female children are detached as mother leaving child 2 attached as the father.

Also the offspring were grouped into detached and attached earlobes. These are represented in tables' I-III. Table III shows the total number of offspring with detached earlobe to be 267(74.17%) 153males and 114females. 93(25.83%) offspring 51males and 42females were attached. Table I and II show offspring with detached and attached earlobe respectively and the parents they got their respective traits. In table I, 57(21.35%) offspring 27males and 30females had fathers with detached earlobe only. 160(59.93%) and 7(2.62%) from both parents with detached and attached earlobe. In table II the highest number of offspring that got attached earlobe from their mothers was only 34.4% while the least number is from both parents with detached earlobe. The expected offspring ratios from the Mendellian crosses between different parental combinations are shown in figs I-V. From these ratios the expected frequencies are calculated from the observed. Using chi-test, the significance of the observed frequencies are tested at $p < 0.05$ (critical value=3.84; and degree of freedom=1) as shown in table 1

The pictures are represented below



Pictures 1: Pictures of family where both parents and all children have detached earlobe.



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



Pictures 3: Mother and child are detached while father attached.



Pictures 4: All family members have attached earlobe.



Pictures 5: Father and child 2 are attached, mother and child 1 detached.



Pictures 6: Mother and all children are detached while father is attached.



KEYS: M = male, F= female

Pictures 7: Father, child1 and 2 are attached while mother and child 3 are detached.

TABLE I: Frequency table showing offspring with detached earlobe

| Parental Combinatn Earlobe Attachment | Total no of offspring | | | No of male Offspring | | No of female offspring | | Cal Chi- value | Critical value | Inference |
|---|-----------------------|----------|--------------|----------------------|----------|------------------------|----------|----------------|----------------|-----------------|
| | Detached | Attached | Total | Detached | Attached | Detached | Attached | | | |
| Father Detached Mother Attached | 57 | 32 | 89 | 27 | 19 | 30 | 13 | 7.02 | 3.84 | Significant |
| Mother Detached Father Attached | 43 | 27 | 70 | 23 | 16 | 20 | 11 | 3.66 | 3.84 | Not Significant |
| Both Parents Detached | 160 | 22 | 182 | 100 | 12 | 60 | 10 | 16.57 | 3.84 | Significant |
| Both Parents Attached | 7 | 12 | 19 | 3 | 4 | 4 | 8 | 2.58 | 3.84 | Not Significant |
| Total | 267 | 93 | 300 | 153 | 51 | 114 | 42 | | | |

TABLE II: Frequency table showing the total number of offspring

| Earlobe attachment | Total no offspring | No of male offspring | No of female offspring | Total % |
|--------------------|--------------------|----------------------|------------------------|---------|
| Detached | 267 | 153 | 114 | 74.17 |
| Attached | 93 | 51 | 42 | 25.83 |
| Total | 360 | 204 | 156 | 100.00 |

All these can be represented using a Mendellian monohybrid cross on the assumption that detached earlobe is the dominant (E) and attached earlobe recessive (e) allele.

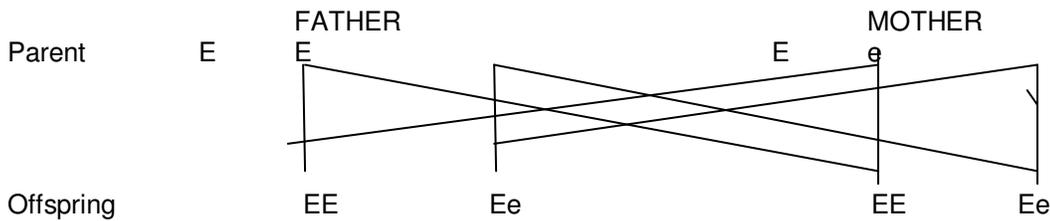


Figure 1: Both parents are with detached earlobe; one homozygous and another heterozygous. Expected offspring ratio is 1:0 (detached:attached), all offspring will have detached earlobe.

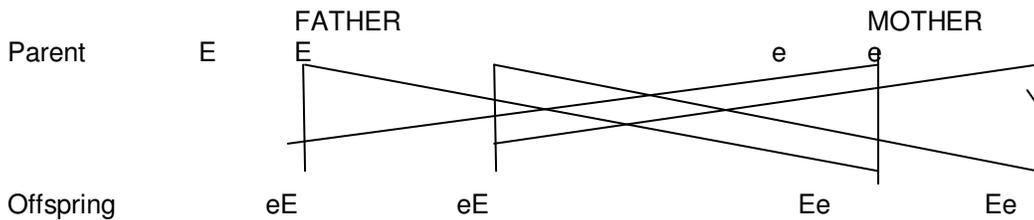


Fig. II: One of the parents is detached (homozygous) and another attached homozygous. Expected offspring ratio is 1:0 (detached:attached), all offspring will have detached earlobe.

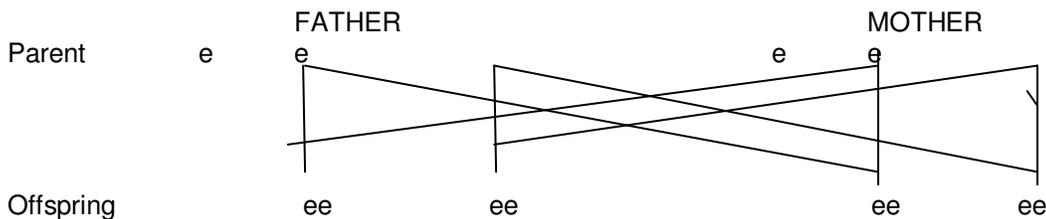


Fig. III: Both parents are attached; homozygous. Expected ratio is 0:1 (detached:attached), all offspring will have attached earlobe.

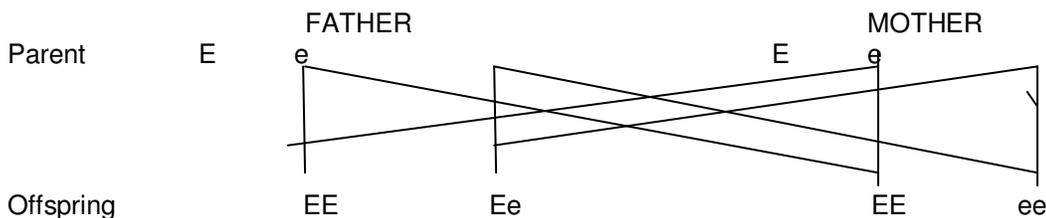


FIG. IV: Both parents are detached; heterozygous. Expected offspring ratio is 3:1 (detached:attached), 75% of offspring will have detached earlobe while 25% will have attached earlobe.

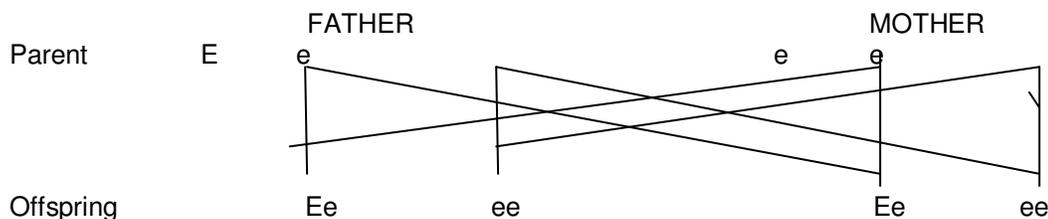


FIG. V: One of the parents is detached heterozygous and another attached homozygous. Expected offspring ratio is 1:1 (detached:attached), 50% of offspring will have detached earlobe while 50% will have attached earlobe.

DISCUSSION

Out of 360 offspring used 74.17% had detached earlobes while 25.83% had attached earlobe (Table II) in the ratio of 3:1. This is similar to the Mendelian monohybrid inheritance using the punnet square. But this result is in contrast to the study amongst the Chinese and Japanese that recorded 66.6% for attached earlobes (Lai and Walsh, 1966).

It agrees with a record of 35.1%, 4.67% and 31.61% for Indian, Jats of Delhi and Ekpoma Nigeria populations for attached earlobe respectively (Sharma et al., 2007). The current study also conforms to the result of Barut and Aktune (2006) where they found that 78.4% of Turkish students had detached earlobe.

One hundred and sixty (59.93%) offspring had detached earlobe and 22 (23.65%) had attached earlobe when both parents had detached earlobe (fig I, table I, and picture I). It is highly significant at $p < 0.05$ with a high ratio of 7:1 this is because the parents who had detached earlobe might either be homozygous (EE) or heterozygous (Ee) in their genetic constitution (Nussbaum et al., 2007). Hundred 100 offspring (37.45%) had either parents with detached earlobe [21.35% from father and 16.10% from mother] as shown in Table I, fig. II, and pictures 2,3,5,6, and 7. These agree with the crosses above.

Seven (2.62%) offspring had detached earlobe and 12 (12.90%) offspring had attached earlobe when both parents had attached earlobe. the 7 offspring is deviation from the cross shown in fig III. It is statically not significant at $p < 0.05$. This suggests that they occurred by chance and might not be true biological children of these parents. Therefore is in conformity with single gene Mandellian dominant-recessive fashion.

Variations in the sizes of earlobes was observed amongst the individuals and within families which might suggest polygenic inheritance, these earlobe variations are due to the differences in the ages of offspring since earlobe increases with age (Anshu et al., 2007) and not polygenic inheritance.

With careful examination of the pictures and the general population of study by their families it will be observed that the way the earlobes are inherited by offspring was independent of sexual differences. Male and female offspring inherited the trait from both mothers and fathers irrespective of the sex. The inheritance pattern then is unlikely to be sex linked or mitochondrial inheritance but rather controlled by autosomal genes which are recessive for attached and dominant for detached earlobe. This is in agreement with when he crossed Rhodes Islands Red and Leghorns (Hays, 1943).

Therefore the pattern of inheritance amongst Nigerians is a dominant recessive single gene Mendellian pattern. It did not differ amongst Nigerian tribes (Williams and Hughes, 2008); this might be due to inter-tribal marriages which encourages inbreeding.

CONCLUSION

The earlobe attachment is actually one of the defining features of the human face. Its subtle variations convey how traits are genetically transmitted from parents. With analysis of a randomised data, this study investigated the inheritance pattern of earlobes attachment amongst Nigerians revealed an inheritance pattern of simple dominance-recessive pattern where detached earlobes are dominant over attached earlobes. In conclusion it is believed that the data from this study will be useful in genetic analysis and determination of parentage.

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