

From the
Department of Human Genetics, University of New South Wales, Sydney,
and New South Wales Red Cross Blood Transfusion Service, Sydney

Observations on Ear Lobe Types

By L. Y. C. LAI and R. J. WALSH

Introduction

Human ear lobes may broadly be classified into two types, free and attached or adherent. Although several studies on the genetics of ear lobe types have been carried out over the past four decades the exact manner of inheritance has never been satisfactorily determined.

In a study of 12 families *Carrière* (1922) suggested that free ear lobe was inherited as a recessive characteristic and attached as a dominant characteristic. *Carrière's* finding was contradicted by *Hildén* (1922) who described portions of three extensive pedigrees in which free ear lobe was inherited as a simple dominant characteristic and attached ear lobe as a simple recessive characteristic. The remainder of the three pedigrees were not reported because the relationship between individuals was complex and inbreeding had occurred in the families. *Hildén's* series was derived from 247 Swedish inhabitants or 92.2% of the total population on the Island of Runo at the time of study.

Quelprud (1934) divided the ear lobes into classes depending on the degree of attachment to the cheek. The distance from the *incisura intertragica* to the point of attachment was measured and expressed as a fraction of the distance from the *incisura intertragica* to the bottom of the lobe. He found, firstly, that when both parents had completely attached lobes no child had lobes which were less than $\frac{3}{5}$ attached, and secondly, that when both parent's lobes were less than $\frac{3}{5}$ attached there were no children with completely attached lobes. *Quelprud* also noted that completely attached lobes were more frequent in females (12%) than in males (7%). *Powell and Whitney* (1937) from a study of two pedigrees each with three successive generations supported *Hildén's* hypothesis that the attached ear lobe was due to a recessive

gene. In one family all 18 members in three generations had free ear lobes and in the other all seven members had attached ear lobes. A marriage between one member of each family produced six children with free ear lobes.

Wiener (1937) examined 124 families with 607 children for ear lobe types and classified them into four arbitrary groups designated as 0, 1, 2 and 3, where 0 corresponded to completely free ear lobe, 3 to completely attached ear lobe. Rare instances were encountered where an individual had one free ear lobe and one attached ear lobe. He suggested that ear lobe types may be controlled by more than a single pair of alleles, or by a single pair of alleles with modifiers. *Riddell* (1942) studied two series totalling 700 subjects and found in each series that the frequency of attached lobes was significantly greater amongst females than amongst males. One female with one attached and one free lobe was observed in the first series, and was classified as "attached". *Kloepfer* (1946) failed to find any evidence of linkage of the ear lobe pattern with other physical characters but demonstrated a definite association between the types of ear lobes in the parents and in the children. *Saldanha* (1962) found no correlation between taste sensitivity to phenylthiourea, middle phalangeal hair and ear lobe character. He classified the ear lobes as free, intermediate and attached, and found a greater frequency of attached type amongst the females than amongst males. This is similar to the finding of *Quelprud* (1934) and *Riddell* (1942). *Gates* (1954) made observations on the crossing between Negroes with attached lobes and Caucasians having mostly free lobes and opined that the inheritance of ear lobe types was complex.

A summary of some of the findings in different ethnic groups is given in Table I. The frequency of individuals with attached ear lobes varies from 11.4% (*Saldanha*, 1960) to 83.9% (*Wiener*, 1937). The present investigation was undertaken to determine the frequencies of ear lobes in some additional ethnic groups and to examine the possibility that the types may be inherited by simple Mendelian factors.

Materials and Method

Two groups of subjects were investigated. The first, termed "Family material", was a series of 160 families with 347 children of the Western Highlands of New Guinea. Details of this group have been described

Table I
Frequencies of attached ear lobes in different ethnic groups

Country and population	Number tested	Individuals with attached ear lobes		Source
		No.	%	
Brooklyn, U. S.: White	248	208	83.9	Wiener
Baltimore U. S.: White	380	—	40.5	Glass et al. (1937)
Pennsylvania U. S.: Dunker Isolate	241	—	25.3	Glass et al. (1952)
Runo Island: Swedish Isolate	247	87	35.2	Hildén (1952)
Great Britain: Scottish 1	500	115	23.0	Riddell (1922)
Scottish 2	200	56	28.0	Riddell (1942)
Brazil: Dutch Immigrant	—	—	11.4	Saldanha (1942)
Brazil: Northern Brazilian	—	—	16.0	Saldanha (1960)
Capaviri, South Brazil: "Mixed"	288	65	22.6	Saldanha (1962)
Canada: Micmac Indian	532	245	46.1	Saldanha (1962)
West Bengal, India: Gandhabanik	100	24	24.0	Chiasson (1962)
Fiji Island: Fijian	813	531	65.3	Dutta (1963)
				Gabel (1958)

elsewhere (Lai and Walsh, 1965). It should be noted that polygamous marriages were common. The second group consisted of six populations. The Chinese were examined in Hong Kong, the Japanese in Tokyo, the Filipinos in Manila, the Australian Aborigines in Darwin, and the Indians from ships in Sydney Harbour. The New Guinea natives consisted of 273 parents of the family material mentioned above and of 126 males tested in the Eastern Highlands.

The lobe was classified as attached (A) when its lowest point was found attached to the cheek, otherwise it was regarded as belonging to the free (F) type irrespective of the degree of freeness. No individual possessing both A and F ear lobes was observed.

Results

Population Data

Sex difference. The distribution of ear lobe types among males and females is given in Table II for the New Guinea Series 1 which is the only group with members of both sexes. The difference in the sex ratios is not significant ($\chi^2 = 2.09$, 1 d.f., $0.20 > P > 0.10$).

Table II
Frequency of attached and free ear lobes among New Guinea natives

Population	Attached		Free		Total
	No.	%	No.	%	
New Guinea Natives: Males	64	59.8	43	40.2	107
Females	115	69.3	51	30.7	166
Total	179	65.6	94	34.4	273

Age distribution. Table III shows the frequency of attached lobes in different age groups of New Guinea natives. It should be pointed out, however, that the ages of New Guinea natives are estimates based on physical appearances because the subjects have no way of knowing their ages. The percentage of attached lobes varies from 56.7 to 82.4 but the differences are not significant ($\chi^2 = 7.34$, 5 d.f., $0.20 > P > 0.10$).

Table III
Frequencies of attached ear lobes in New Guinea natives of various age groups

Age (years)	Number examined	Attached ear lobes	
		No.	%
10—19	29	22	75.9
20—29	95	64	67.4
30—39	113	73	64.6
40—49	104	59	56.7
50—59	41	25	61.0
60+	17	14	82.4
Total	399	257	64.4

Ethnic differences. The frequencies of attached ear lobes in six populations are listed in Table IV. They range from 22.0% in Australian aborigines to 67.1% in Japanese and the differences are significant ($\chi^2 = 57.32$, 5 d.f., $P < 0.001$). The frequencies amongst the Chinese, Filipinos and the New Guinea natives are similar to those for the Japanese ($\chi^2 = 0.19$).

Table IV
Frequencies of attached ear lobes in different ethnic groups

Country and population	Number tested	Individuals with attached lobes	
		No.	%
Indian Sub-Continent: Indians	111	39	35.1
Australia: Aborigines	41	9	22.0
Hong Kong: Chinese	70	45	64.3
Japan: Japanese	70	47	67.1
Manila: Filipinos	49	32	65.3
New Guinea: Natives	399	257	64.4

Family data. The distribution of marriage types found in 160 New Guinea families is shown in Table V. This does not differ significantly from the distribution expected as a result of random assortment ($\chi^2 = 3.80$, 2 d.f., $0.20 > P > 0.10$). Table V also shows the phenotypic expression found in 347 offspring of these matings. Fertility is almost identical in all three matings.

Table V
Family data of New Guinea natives

Types of mating	Numbers observed	Per cent observed	Children		F	Numbers	%	Total
			A	%				
A × A	58	36.2	90	70.9	37	29.1	127	
A × F	86	53.8	114	61.3	72	38.7	186	
F × F	16	10.0	22	64.7	12	35.3	34	
Total	160	100	226		121		347	

The possibility was tested that the ear lobe phenotypes could be due to a single gene effect. Gene frequencies were calculated by the *Hardy-Weinberg* formula on the basis that the responsible gene is an autosomal dominant or an autosomal recessive gene. In the case where the phenotype may be due to a dominant sex-linked gene or to a recessive sex-linked gene, gene frequencies were computed by a

maximum likelihood method (Neel and Schull, 1954). The expected numbers of offspring of different phenotypes were then obtained by Snyder's method (Snyder, 1934).

The possibilities are:

1. Attached lobes are determined by a dominant autosomal gene and are found in both heterozygous and homozygous subjects.
2. Attached lobes are determined by a recessive autosomal gene and are found only in homozygous individuals.
3. Attached lobes are determined by a dominant sex-linked gene and are found in hemizygous males and both heterozygous and homozygous females.
4. Attached lobes are determined by a recessive sex-linked gene and are found in hemizygous males and homozygous females.

All four possibilities were tested by calculating chi-square values between the observed and expected numbers. Significant differences were found in all instances and P was always less than 0.001. These results are therefore inconsistent with the possibility that any type of single gene effect is responsible for the phenotypic manifestation of ear lobe types.

Discussion

The frequency of attached ear lobes was comparable in four of the ethnic groups studied, namely, Chinese, Filipinos, Japanese and New Guinea natives. However, the frequencies observed in these groups were considerably higher than those found amongst the Indians and the Australian aborigines. That amongst the aborigines (22.0%) was approximately the same as was found in a "mixed" population of South Brazil (Saldanha, 1962) and close to the values of the Dunker Isolate in Pennsylvania (Glass *et al.*, 1952) and of the Gandhabaniks in West Bengal (Dutta, 1963). The incidence in the Indian population (35.1%) was similar to that reported for the Swedish Isolate (35.2%) investigated by Hildén (1922).

The Chinese, Filipino, Japanese and New Guinea natives of the present study and the Fijians examined by Gabel (1958) have frequencies which fall into a narrow range (61.9–67.1%).

It must be stressed that the present study did not include an investigation of differences within groups. Such differences occur, because the incidence of attached ear lobes in the Brooklyn Whites

studied by Wiener (1937) was 83.9% and in the Baltimore Whites studied by Glass and group (1952) was 40.5%.

Wiener (1937) studied 124 families with a total of 607 children. His material has been analysed in the same manner as the New Guinea family material presented in this paper. The sex of the offspring was not stated and it was therefore not possible to consider the hypothesis of a sex-linked gene effect. However, neither a dominant autosomal gene theory nor a recessive autosomal gene theory can explain Wiener's data. This conclusion is contrary to that of Carrière (1922), Hildén (1922), Powell and Whitney (1937) and Quelprud (1941).

It has been assumed that the ear-lobe phenotype of an individual is an inherited characteristic and this seems a reasonable hypothesis for such a clearly defined characteristic. No direct evidence has been produced to support this belief although the ethnic differences which have been demonstrated in several studies allow the possibility of a multifactorial genetic mechanism such as has been suggested by Wiener (1937) and Gates (1941). It must be concluded from the family data presented that a single gene effect is unlikely to be the mechanism.

Summary

A family and population study of ear lobe types has shown that the distribution varies considerably among populations but is independent of age and sex. Detailed analysis of the present family data has shown that a simple Mendelian gene effect is unlikely to be responsible for the ear lobe types.

REFERENCES

- Carrière, R.: Über erbliche Ohrformen, insbesondere das angewachsene Ohrläppchen. Z. Abst. Vererb. (1922).
- Chiasson, L. P.: Gene frequencies of the Micmac Indians. J. Hered. 54: 229-236 (1963).
- Dutta, P. C.: A note on ear lobe. Acta genet., Basel 13: 290-294 (1963).
- Gates, R. R.: Etudes sur le croisement de races (III Nouvelles observations concernant les oreilles, en particulier les lobes). J. Génét. hum. 3: 95-112 (1954).
- Glass, B.; Sacks, M. S.; Jahn, E. F. and Hess, C.: Genetic drift in a religious isolate: an analysis of the causes of variation of blood group and other gene frequencies in a small population. Amer. Nat. 86: 145-159 (1952).
- Hildén, K.: Über die Form des Ohrläppchens beim Menschen und ihre Abhängigkeit von Erbanlagen. Hereditas (Lund) 3: 351-357 (1922).

- Kloepfer, H. W.: An investigation of 171 possible linkage relationships in man. Ann. Eugen., Lond. 13: 35-37 (1946).
- Lai, L. Y. C. and Walsh, R. J.: The patterns of hand clasping in different ethnic groups. Hum. Biol. 37: 312-319 (1965).
- Neel, J. V. and Schull, W. J.: in Human Heredity, p. 185. (Chicago University Press, Chicago, Ill. 1954.)
- Powell, E. F. and Whitney, D. D.: Ear lobe inheritance. J. Hered. 28: 184-186 (1937).
- Quelprud, T.: Familienforschungen über Merkmale des äußeren Ohres. Z. Abst. Vererb. 67: 296-299 (1934).
- Riddell, W. J. B.: Studies in the classification of eye colour I. Ann. Eugen. Lond. II: 245-259 (1942).
- Saldanha, P. H.: Frequencies of consanguineous marriages in Northeast of São Paulo, Brazil. Acta genet., Basel 10: 71-88 (1960).
- Saldanha, P. H.: The genetic effects of immigration in rural community of São Paulo, Brazil. Acta genet. med., Roma 11: 158-224 (1962).
- Snyder, L. H.: Studies in human inheritance. X. A table to determine the proportion of recessives to be expected in various matings involving a unit character. Genetics 19: 1-17 (1934).
- Wiener, A. S.: Complications in ear genetics. J. Hered. 28: 425-426 (1937).

Authors' address: Dr. L. Y. C. Lai and Prof. R. J. Walsh, Dept. of Human Genetics, University of New South Wales, c/- N.S.W. Red Cross Blood Transfusion Laboratories, 1 York Street, Sydney (Australia).