

# Evidence for a Genetic Cline in Earwax Types in the Middle East and Southeast Asia<sup>1</sup>

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**ABSTRACT** Data obtained on cerumen types in the Middle East and Southeast Asia indicate frequencies for the dry allele that are intermediate between previously reported high values in the northern Orient and low values in Caucasian and Negro populations. This evidence in combination with previously existing data reveals a genetic cline in earwax types in this part of the world.

The genetic dimorphism and distribution of human cerumen (earwax) types have been documented by a number of investigators (Matsunaga, '62; Petrakis et al., '67; Nakajima and Hirano, '68). Phenotypically, human cerumen is wet (sticky) or dry (hard) and controlled by a pair of genes in which the allele for the wet type is dominant over that for the dry. The homozygous and heterozygous wet types are phenotypically indistinguishable. The frequency of alleles for dry and wet cerumen varies distinctly with race. The dry allele is prevalent in "mongoloid" populations of Asia and in Amerindians (Petrakis, '69; Martin and Jackson, '69; Niswander et al., '70; Nakajima and Hirano, '68) and the wet allele, in American white and Negro populations and natives of New Guinea (McCullough and Giles, '70).

During a recent journey by car from Turkey to Malaysia, we examined cerumen types in several populations in Eastern Turkey, Northern Iran, Afghanistan, Central India, and Malaysia. We also examined a few Indian students in London. Our criteria for classification of cerumen type were those employed by Matsunaga ('62) and Petrakis et al. ('67). Cerumen in both ears was examined with an otoscope and classified according to Matsunaga's criteria. Classification was occasionally facilitated by use of an ear curette. In some cases lack of personal cleanliness made it impossible to determine the phenotype. The dry type was granular or scaly and grey to light tan, and did not adhere to the otoscope or

curette; the wet type was thick and sticky (resembling thick honey in consistency) and light to dark brown, and adhered to the otoscope and curette. An infrequent, intermediate, "transitional" form has been reported by Hirschhorn ('70); however, this variant is difficult to distinguish clearly from the wet type because of such common environmental factors as dirt and humidity. We did not attempt to identify this type. Table 1 shows our results. These, in combination with the data published earlier, suggest that the dry allele is found significantly more often in the Middle East and in Southeast Asia than in Caucasian and Negro populations.

Reasons for this variation in the global distribution of cerumen types remain unknown. Recently McCullough and Giles ('70) suggested that the variation might be related to relative humidity and its selective influence through different rates of external ear canal infection in the two types of cerumen. They hypothesized that wet cerumen was associated with decreased resistance to external otitis, which could ultimately lead to otitis media, mastoiditis, and death from general cranial infection. Their hypothesis appears to be in agreement with recent findings (Petrakis et al., '71) of an association of lysozyme and immunoglobulin

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TABLE 1  
*Dry cerumen in the Middle East and Southeast Asia*

| Peoples <sup>1</sup> | Total examined | No. dry | No. unclassifiable | Dry  | Estimated frequency of dry Allele <sup>2</sup> | Standard error <sup>3</sup> |
|----------------------|----------------|---------|--------------------|------|------------------------------------------------|-----------------------------|
|                      |                |         |                    | %    |                                                |                             |
| Turks                | 105            | 29      | 3                  | 27.6 | 0.525                                          | 0.058                       |
| Turkomans            | 54             | 18      | —                  | 33.3 | 0.577                                          | 0.078                       |
| Afghans              | 78             | 12      | 5                  | 15.4 | 0.392                                          | 0.073                       |
| Indian Students      | 48             | 11      | 2                  | 22.9 | 0.478                                          | 0.089                       |
| Tribal Indians:      |                |         |                    |      |                                                |                             |
| Gonds                | 243            | 42      | 5                  | 12.1 | 0.351                                          | 0.042                       |
| Naikpods             | 90             | 13      | 10                 | 14.4 | 0.379                                          | 0.068                       |
| Koyas                | 114            | 14      | 10                 | 12.3 | 0.351                                          | 0.061                       |
| Harijans             | 69             | 8       | 5                  | 11.6 | 0.340                                          | 0.080                       |
| Malaysians:          |                |         |                    |      |                                                |                             |
| Orang Asli           |                |         |                    |      |                                                |                             |
| (Aborigines)         | 133            | 9       | 6                  | 6.8  | 0.261                                          | 0.059                       |
| Malays               | 78             | 21      | 3                  | 26.9 | 0.519                                          | 0.068                       |
| Total                | 1012           |         |                    |      |                                                |                             |

<sup>1</sup> Populations reported in this study were as follows: Turks—outpatients attending Ataturk University Medical School Hospital, Erzurum, Turkey.  
Turkomans—of Turkoman origin and living in Gonbad, Iran.  
Afghans—inpatients from the Aveccina Hospital, Kabul, Afghanistan.  
Indian students—attending University College, London. From all parts of India.  
Tribal Indians—from near Sirpur, north of Hyderabad, India.  
Malaysians  
  Orang Asli—inpatients in the hospital of the Department of Aborigine Affairs, near Kuala Lumpur.  
  Malays—students at the Institute for Medical Research, Kuala Lumpur.

<sup>2</sup> Gene frequencies were calculated from the square root of percentage values found for the recessive dry phenotype.

<sup>3</sup> Standard errors were determined by the formula  $SE = \sqrt{\frac{1-q^2}{2N}}$ , where  $q^2$  is the frequency of the dry allele, and  $N$  is the number of persons examined.

IgG with dry cerumen, suggesting that this type of earwax might protect against ear infections; however, such fatal complications are never associated with external otitis, although they are commonly associated with otitis media. Despite this laboratory evidence for an antibacterial potential of dry cerumen, unpublished studies (J. B. Gregg, personal communication) of Sioux Indians in southwestern South Dakota indicate no significant difference in the rate of external or middle ear infections associated with the two cerumen types. Therefore it is unlikely that external ear canal infections could have exerted selection pressures great enough to influence directly the global distribution of earwax types. Before an adaptive hypothesis for cerumen type can be accepted, extensive controlled clinical studies on different racial groups under various environmental conditions will be required. Cerumen dimorphism also could represent a morphological manifestation of a pleiotropic gene that affects other

systems of resistance to infection (Petrakis et al., '71).

Other explanations for the dimorphism have been offered. Adachi's ('37) finding of both types of cerumen in chimpanzees suggests that the dimorphism was established early in primate evolution and that current geographic correlations with relative humidity may be the heritage of ancient selection pressures. Matsunaga suggested that persons with wet cerumen often have an associated axillary apocrine odor that might influence sexual selection in different cultural settings. No evidence for or against this hypothesis has been advanced.

Our present observations, considered along with prior data on frequencies of cerumen types, imply the existence of a cline for dry cerumen, with its frequency high in Mongolian Asia and decreasing as one moves into the Middle East, Southeast Asia, and Europe (fig. 1). We conclude that the high frequency of dry cerumen in the Middle East and South-

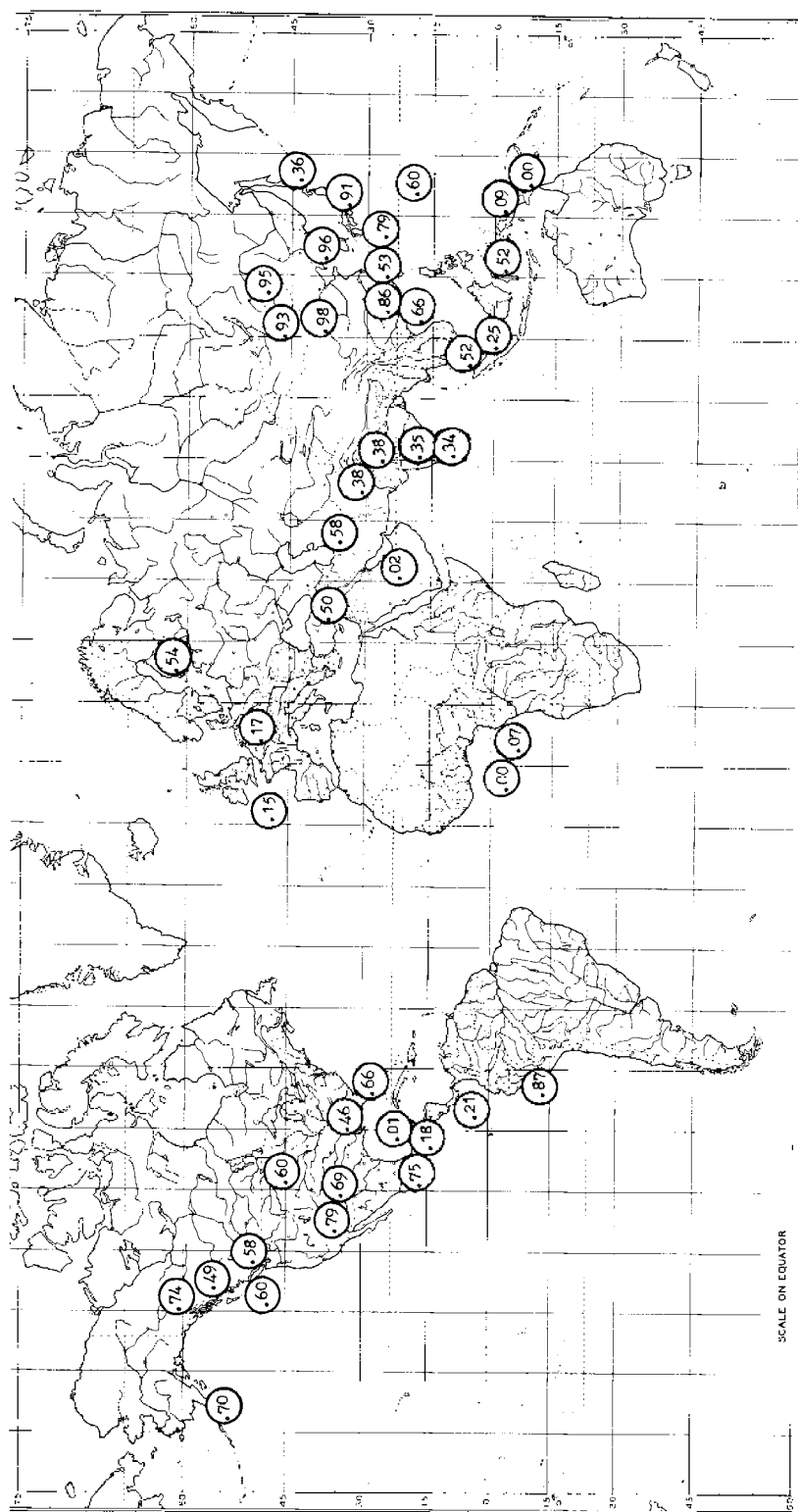


Fig. 1 Frequency of the allele for dry cerumen. Sources of data: *Asia and the South Pacific*—Japan, Korea, Mongolia, China, Micronesia (Matsunaga, '62). New Guinea (McCullough and Giles, '70). *Europe*—Germany (Matsunaga, '62). Western Europe, from U. S. whites of European origin (Petrakis, '69). Finland, from Finnish immigrants living in the San Francisco Bay Area (Petrakis, unpublished observations). *Africa*—Data shown for sub-Saharan Africa are from U. S. Negroes (Matsunaga, '62; Petrakis, '69). *North and South America*—Americans (Petrakis et al., '67; Petrakis, '69; Kalmus et al., '64; Martin and Jackson, '69; Niswander et al., '70; McCullough and Giles, '70). Yukon and Northern British Columbia (M. L. Lee, University of British Columbia, unpublished data). Saudi Arabia—Shia Arabs (unpublished data of Richard Petrine, M.D., Department of Medicine, Aramco, Dharhan, Saudi Arabia).

east Asia probably reflects an introduction of the dry allele into indigenous populations during prehistoric and historic migrations and invasions from central and eastern Asia. The high frequency of dry cerumen in Amerindians may reflect early migrations from the peak of this cline, combined with effects of unknown selection pressures and non-mongoloid admixtures.

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