A72 A New Application for Estimating Ancestry Based on Dental Morphology

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After attending this presentation, attendees will better understand how dental morphological traits vary across the globe and how this variation can be used to estimate the ancestry of individuals in a forensic context.

This presentation will impact the forensic science community by providing an additional method for ancestry estimation that can be adopted by forensic anthropologists for use in the development of the biological profile.

A statistical application using R was developed to estimate the ancestry of unknown individuals using tooth crown and root morphology.[1] A global reference sample of 21 dental traits was created from the Christy G. Turner II database consisting of approximately 30,000 individuals. These individuals were subdivided into seven geographic regions (American Arctic and Northeast Asia; Australo-Melanesia and Micronesia; East Asia; American Indian; Southeast Asia and Polynesia; Sub-Saharan Africa; and Western Eurasia) for ancestry estimation. To classify an unknown individual, dental traits are scored according to the Arizona State University Dental Anthropology System and entered into the application as present, absent, or unobservable, according to predetermined breakpoints.[2] The statistical program first derives a Nei's distance matrix, followed by a hierarchical clustering tree using an Unweighted Pair Group Method with Arithmetic Mean (UPGMA) algorithm with complete linkage. Posterior probabilities are then assigned for the unknown set of remains to each of the seven biogeographic groups using a naïve Bayes classifier algorithm.

A web-based application of this program, called rASUDAS, was used to test the accuracy of the method. In an analysis of a test set of 150 individuals of known ancestry from all parts of the world, the application correctly assigned individuals to their geographic group between 57% and 92% of the time. When limited to the broader ancestry groups of European, African, and Asian, correct assignment increased to between 82% and 92%.

The rASUDAS program is extremely flexible; it is able to accommodate missing data and allows the user to choose which biogeographic groups to include in the model; however, in its current form, the reference sample for this program is based predominantly on individuals from archaeological sites with considerable temporal depth. More work is needed to understand the effects of secular change on dental morphology before the method can be broadly adopted in a medicolegal context. The ultimate goal is to grow the reference sample to include modern individuals to enhance the utility of the program.

This study identifies broad patterns in crown and root traits as related to ancestry. The efficacy of the method outlined here highlights the utility of these data as part of the biological profile. As dental traits are directed by different developmental processes than those traditionally analyzed for ancestry estimation (i.e., cranial metrics, cranial morphoscopics, and postcranial morphology), the inclusion of dental morphological data can provide a more robust view of population histories and improve the estimation of ancestry within forensic anthropology.

Reference(s):

1. R Core Team. 2013. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. ISBN 3-900051-07-0, URL http://www.R-project.org.
2. Turner, Christy G., Christian R. Nichol, G. Richard Scott. 1991. Scoring Procedures for Key Morphological Traits of the Permanent Dentition: The Arizona State University Dental Anthropology System. In *Advances in Dental Anthropology*, edited by M.A. Kelley and C.S. Larsen. New York: Wiley-Liss.

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