A33 A Multiple Classifier System Approach to Determining Ancestry of Fragmentary Remains: A Preliminary Study

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After attending this presentation, attendees will understand how to utilize a multiple classifier system to best estimate ancestry from human skeletal remains and to select the best-suited methods of ancestry estimation when analyzing fragmentary remains.

This presentation will impact the forensic science community by encouraging a holistic approach to determining ancestry by combining extensive theoretical and methodological research and data collection of previous researchers in attempts to increase reliability of ancestry estimations in the future.

The goal of this research was to assess the most commonly available indicators of ancestry in a fragmented skeletal collection and test a statistical framework for combining all available methods.

Various methods for determining ancestry have been explored, most notably cranial and postcranial metrics, cranial morphology, dental metrics, and dental nonmetric traits, yet little effort has been made to combine these methods for comprehensive ancestry estimation.[1] Furthermore, the current approaches are heavily dependent on complete or mostly complete skeletal remains. The most frequently used methods of ancestry estimation are cranial and postcranial metrics, which are classified via Discriminant Function Analysis (DFA) in the FORDISC® software. Such customized software packages allow for the input of partial datasets; however, these methods are rarely feasible when dealing with fragmentary remains.

This study focuses on combining dental metrics, dental non-metric traits, and cranial macromorphoscopic traits to assess the ancestry of 67 individuals from the Mississippi State Asylum (MSA) Cemetery in Jackson, MS. The asylum records divided the institutionalized population into two classifications of social race (White and Black) and, therefore, a binary classification was developed using European and African American reference datasets. Cranial and postcranial metrics were not used for this study due to the high degree of fragmentation and poor preservation. Individuals with no dentition represented were excluded as this only leaves cranial macromorphoscopic traits to be assessed, reducing the sample to 57 individuals. Dental metrics for each MSA individual were entered into FORDISC® 3.0 and referenced to a dataset of American Blacks and Whites from the University of Tennessee College of Dentistry, Memphis, TN, using the custom import feature in order to calculate posterior and typicality probabilities.[2] Posterior probabilities were then calculated for each individual using dental non-metric traits referenced to frequencies developed by Edgar.[3] Finally, cranial macromorphoscopic were assessed using seven traits established by Hefner.[4] All observed macromorphoscopic traits were incorporated into a Bayesian classifier to calculate posterior probabilities, but this method was limited due to fragmentation. The group of posterior probabilities from the dental metrics, dental non-metric traits, and macromorphoscopics was then averaged, where each classifier was weighted equally.

When comparing the ancestry classifications across methods, 38 of the 57 individuals (66.67%) had consistent classifications. Of the 38 individuals with consistent ancestries, 84.21% had average posterior probabilities greater than 0.75. While there does not appear to be any significant correlations between the consistency of classification across methods and the number traits or metrics used, there is a strong positive correlation between the number of dental non-metric traits used and the posterior probability (r=0.43, p=0.0008). The limited sample size for macromorphoscopic traits rendered correlation tests insignificant; however, it should be noted that the combination of characteristics likely determines accuracy of the methods rather than quantity of metrics and non-metric traits. A discussion will be provided on the availability of each characteristic used to classify the fragmentary remains and trends in combinations of variables, as well as their correlations, within each classifier for all cases of consistent classifications. Additionally, the utilization and issues encountered when dealing with cranial macromorphoscopic traits will be presented.

Jantz and Hefner recommend that researchers embrace the theory of forensic race estimation by providing empirical data engrained with concepts of human variation.[5] This study is an example of such research targeted at creating appropriate and reliable statistical methods for determining ancestry of unidentified remains, as well as an aid in improving the establishment of biological profiles of fragmentary remains.

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Ancestry, Fragmentary Remains, Multiple Classifier Systems