A77 Population Classification Using Discriminant Function Analysis of Combined Mandibular Osteometrics and Non-Metric Traits

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The goal of this presentation is to evaluate various combinations of mandibular non-metric traits and osteometrics for their efficacy in classifying individuals based on ancestry.

This presentation will impact the forensic science community by demonstrating that classification rates using the mandible for ancestry assessment can be used accurately and reliably.

It is widely known that the cranium is the most diagnostic area of the skeleton for ancestry assessment; however, the cranium is often damaged or distorted by trauma or taphonomic processes, making accurate morphological and metric assessments difficult or even impossible. Thus, other skeletal elements must be evaluated for their usefulness in assigning ancestry to unknown skeletal remains. Widely available tools such as FORDISC® 3.0 allow one to make an assessment based on mandibular osteometrics, however, in practice, inclusion of mandibular variables tends to limit population sample sizes. When used in conjunction with other standard cranial measurements, their inclusion may confound some discriminant function model interpretations. Researchers have recently turned to analyzing non-metric traits of the mandible, yet these traits are rarely used in combination with the full suite of morphological characteristics utilized for ancestry assessment.

In the current study, non-metric traits previously found useful for population-based classifications (inversion of the ramus, eversion at the gonial angle, chin shape, shape of the mandibular border, and presence/absence of a mandibular torus) were combined with several standard mandibular osteometrics (mandible length, gonial width, bicondylar width, mandibular angle, and minimum ramus breadth) and tested for classification accuracy using Linear Discriminant Function (LDF) and canonical variates analysis. Scoring of these mandibular variables are different than those previously published by Berg.[1] A total of 963 individuals of European (205 male, 207 female), African (292 male, 195 female), and Asian (40 male, 24 female) ancestry, spanning three continents, were analyzed using the custom database feature in FORDISC® 3.0. These samples include individuals of European and African ancestry from South Africa as well as the United States, while the Asian sample derives from Thailand. Using the ten combined traits, this study seeks to discern whether correct classifications can be obtained and refined for various logical iterations of "lumping" and "splitting" the populations based on shared geographic ancestry and sex (e.g., pooled males and females of combined African, European, and Asian groups).

It is recognized that combining ordinal and continuous data violates some assumptions of LDF analysis; thus, the various iterations and variables are analyzed critically. Correct classification rates, positive predictive values, specificity, sensitivity, and efficiency are used as tests of efficacy. In a three-way test of European, African, and Asian males and females combined (n = 547), the model provides an overall cross-validated Correct Classification Rate (CCR) of 76.2% using ten variables. Two-way tests between African and European (n = 485), African and Asian (n =345), and Asian and European (n = 264), using the same ten variables, yield CCRs of 81.0%, 89.3%, and 85.2%, respectively. Results indicate that the classification rates based on these combinations are on par with Berg's discriminant functions for "forensically interesting groups," which have accuracies ranging from 58.1%-91.4%.[1] This further demonstrates the validity of "mandible only" ancestry determination methods as an accurate and reliable technique for ancestry assessment.

Reference(s):

1. Berg G.E. Biological affinity and sex from the mandible using multiple world populations. In: Berg G.E., Ta'ala S., editors. *Biological affinity in forensic identification of human skeletal remains: beyond black and white.* Boca Raton: CRC Press, 2015:43-82.

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