A115 Ancestral Variation of the Relative Proportionality of Skeletal Facial Features: A Metric Assessment

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Learning Overview: The goal of this presentation is to assess and describe the relative proportionality of skeletal facial features and their variation by ancestral origin. After attending this presentation, attendees will understand the covariance of select craniofacial attributes.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by contributing empirical, metrically based observations of how facial features covary with each other, developing a basis to define suites of meaningful traits for skeletal analyses. The results of this study can inform the evaluation of macromorphoscopic traits when assessing a skeletal individual's ancestral affiliation.

Standard non-metric approaches to skeletal ancestry assessment rely on analyses of the shape or size of individual facial features, which are sometimes considered in isolation and sometimes in relation to other traits or to the somewhat vague "facial skeleton" as a whole. This presentation seeks to better define the proportional relationships between various facial features that are commonly used in non-metric sex assessment and to test the hypothesis of positive scaling between overall facial dimensions and the dimensions of pertinent facial features.

This study accessed 3D cranial scans and demographic data of 27 (Black=8; Hispanic=3; White=16) identified individuals analyzed at the University of Florida C.A. Pound Human Identification Laboratory between 1989 and 2018. Selection of individuals included the following criteria: (1) 3D cranial surface scans, collected using a NextEngine™ 3D Laser Scanner and ScanStudio™ software, were available; (2) an age of at least 18 years at death; and (3) select craniofacial landmarks were not affected by pathological conditions, trauma, postmortem damage, or anomalous variation. Coordinate data of 14 craniofacial landmarks were collected for each individual and analyzed in R™.[1] From these data, Inter-Landmark Distances (ILDs) were calculated for eight craniofacial dimensions representing widths or heights of various facial features: nasal height; nasal aperture height; nasal aperture width; facial height; upper, middle, and lower facial widths; and interorbital breadth. Linear model regression analyses were then performed to evaluate ILD relationships.

A factorial Multivariate Analysis of Variance (MANOVA) demonstrated that while the main effects of sex and ancestry were both significant ($p=0.017$ and $p=0.039$, respectively), their interaction was not; thus, sexes were pooled for further analyses. Results indicate weak-to-moderate (R^2 values range between 0.24 and 0.39) but significant ($\alpha=0.05$) correlations between all width/breadth ILD pairings, except the comparison of interorbital breadth to lower facial width. This supports that facial features in anatomical proximity to each other (i.e., their development is linked, or they undergo similar biomechanical stresses) are more likely to have meaningful covariation, suggesting that suites of certain traits and their relative proportionalities should be considered in ancestry assessments. Unsurprisingly, given the proximity of nasospinale and prosthion, nasal height is significantly correlated with total facial height in the pooled sample ($R^2=0.43$, $p=0.0002$); however, correlations between nasal aperture height/facial height and nasal aperture height/nasal height reach significance only for the White group.

There is a discernable pattern to the sorting of the Black and White groups in the majority of these comparisons of facial proportionality, with minimal to moderate overlap of these groups. The Hispanic individuals did not sort into any discernible group or pattern, instead generally falling into intermediate morphospace, likely resulting from both their low sample size and issues with using "Hispanic" as a category for ancestral affiliation. The results reveal several expected outcomes, including that Black individuals have absolutely wider nasal apertures and White individuals express absolutely taller nasal apertures, resulting in the nasal proportions typically associated with these two groups. Conversely, interorbital breadth does not demonstrate separation among the ancestry groups, with the range of measurement values for Black individuals encompassing that of both the White and Hispanic samples. This suggests, for instance, that relative assessments of nasal aperture to interorbital widths do not strongly inform ancestry estimations, especially since these variables are correlated within individuals.

In summary, these results suggest that certain traits considered in isolation—such as absolute nasal width—can be informative of ancestry. Further, when assessing a particular trait relative to aspects of the facial skeleton, the utility of a given comparative trait varies; certain facial features serve as more appropriate comparative variables for a given trait than others and, thus, should be explicitly included in descriptions of non-metric scoring for applicable traits.

Reference(s):

1. R Core Team. 2018. *R: A Language and Environment for Statistical Computing.* (Version 3.5.0 (2018-07-01)). R Foundation for Statistical Computing, Vienna, Austria.

Craniofacial Proportions, Ancestry Assessment, Macromorphoscopic Traits