H4 Population Variation in the Sacrum

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Upon the conclusion of this presentation, attendees will have a better understanding of population differences in the sacrum and the feasibility of using sacral morphology to identify the ancestry of human skeletal remains.

This presentation will impact the forensic community and/or humanity by expanding the available information characterizing population differences in post-cranial morphology, and also informing the forensic community on the limitations of using the sacrum in identifying the ancestry of skeletal remains. This research also serves as a case study on the effects of sample selection on classification accuracy relevant to all general research using osteometric determination of ancestry.

This study tested the hypothesis that individuals of African-American ancestry could be distinguished from other populations based on osteometric analysis of the sacrum. The study was initially prompted by casual observations of a distinct “pinching” at the level of the second sacral vertebra and a narrower overall breadth relative to length among AfricanAmericans in comparison to Americans of European descent. Using 610 sacra from mature individuals in the skeletal collections of the National Museum of Natural History, Smithsonian Institution, three standard measurements were taken as defined by the Buikstra and Ubelaker standards: anterior length (AL), anterior superior breadth (APB), and the maximum transverse diameter of the base (TDB). Two additional measurements were added: the curved length of the sacrum at the midsagittal plane (CL), and the minimum breadth at the level of the second sacral vertebrae (MS2). The maximum height of curvature (HC) was obtained by subtracting the anterior length from the curved length. Two indices were calculated by dividing MS2 by either AL or APB and multiplying by 100.

Four hundred sacra sampled from the Terry skeletal collection were evenly distributed by ancestry (African-American, European-American) and by sex. The Native American sample included 84 males and 83 females from South Dakotan Arikara sites and the New Mexican sites of Hawikuh and Jemez. A sample of 43 individuals of Chinese ancestry from California included males only. Statistical procedures for univariate analysis included descriptive statistics and ANOVA procedures to assess among group differences with a Bonferroni adjustment applied to pair-wise comparisons. Direct discriminant function analysis with cross-validation used the five measured variables (AL, CL, APB, TDB, MS2) to assess the overall effectiveness of multivariate ancestry determination. All statistical analyses were performed separately for males and females using Systat 11 software.

In males and females, the ANOVA analysis showed significant differences for all of the variables among African-Americans, EuropeanAmericans, and Native Americans. In pair-wise comparisons of males, African-American sacra were significantly shorter (AL and CL) narrower (APB) and more pinched (MS2) than either Native Americans or European-Americans. European-Americans had significantly greater curvature (HC), while Native Americans had significantly broader promontories (TDB) and higher indices. All trends were similar in females, and the only discrepancies in the results were that AL and CL differences were not significant between the African American and Native American samples for females. Discriminant function analysis correctly classified 70% of males and 74% of females when the three populations were included. While classificatory accuracy did increase to 79% for males when the categories were reduced to African American vs. non-African American, the hypothesis of a distinct morphology in the former population required some modification. Female accuracy did not change with the reduction to the two-category classification system. Correct classification was also highest for Native Americans at 81% for males and 88% for females versus only 66% and 71% respectively for African Americans. When the Chinese sample was included, correct classification decreased to 66% for males (63% for African Americans; 70% for Chinese; 70% for Native Americans, and 64% for European Americans). While the Chinese males did show some of the expected similarities to Native Americans, they are also similar to African Americans in the measurements of pinching (MS2) and overall narrowness (APB). These results suggest that some of the hypothesized “unique” characteristics of the African Americans initially observed are contingent on the populations included in the analysis. The phenomenon of convergence among populations with the addition of larger, more diverse samples has been noted in other studies, but its critical importance in the accuracy of ancestry determination can not be overemphasized.

The presentation of this research not only expands the available information characterizing population differences in post-cranial morphology, it also informs the forensic community on the limitations of using the sacrum in identifying the ancestry of skeletal remains. This research also serves as a case study of the effects of sample selection on classification accuracy relevant to all research and forensic applications that use osteometric determinations of ancestry.

Ancestry, Osteometrics, Sacrum

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