



A40 A Cranial-Postcranial Approach to Metric Ancestry Estimation Among Modern South Africans

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After attending this presentation, attendees will better understand the potential of employing a combined cranial-postcranial approach to estimate ancestry in modern South Africans. The combined approach will be compared to previous cranial and postcranial studies to highlight the improvement in accuracy over previous assessment methods.

This presentation will impact the forensic science community by contributing to knowledge on craniometric and postcraniometric variation observed among modern Black, Colored, and White South Africans and the potential of a combined methodology for estimating ancestry.

The cranium is recognized as the most reliable indicator of ancestry and is the preferred bone for assessing ancestry in South African anthropological casework. Recently a postcraniometric approach to ancestry on a South African sample yielded comparable results to accuracies achieved by previous craniometric studies, demonstrating the potential use of postcrania in ancestry estimation.¹ Despite high accuracies obtained with both cranial and postcranial data, large amounts of overlap between the three major South African groups limits the predictive accuracy of the elements in providing a definitive ancestry estimate.² A more holistic method assessing both cranial and postcranial measurements simultaneously would include the most discriminatory variables of the entire skeleton, resulting in better group separation than when crania and postcrania are evaluated separately.¹ The current research seeks to explore a combined cranial-postcranial approach to metric ancestry estimation in a modern South African sample.

A total of 38 standard measurements were taken from the cranium and ten postcranial bones. The sample consisted of 360 modern South African individuals (120 Black, 120 White, 120 Colored) from the Pretoria Bone and Kirsten Collections housed at the University of Pretoria and the University of Stellenbosch, respectively. Group differences were explored with Analysis of Variance (ANOVA) and Tukey's Honestly Significant Difference (HSD) test. Multivariate classification models were assessed using Linear Discriminant Analysis (LDA). Classification accuracies achieved for a variety of multivariate models were compared to previous cranial and postcranial studies to evaluate the potential of the holistic approach.

The results demonstrated variable patterns of group overlap. Consistent with previous studies, Black and Colored South Africans displayed overlap for the majority of the variables; however, 11 variables inclusive of all lengths of the distal limb segments, breadth measurements of the orbit and nasal aperture, interorbital breadth, mastoid height, and the femoral transverse subtrochanteric diameter were found to be significantly different between the two groups ($p < 0.05$). White South Africans displayed larger measurement means for all postcranial variables, except the lengths of distal limb segments, whereas Black South Africans had the largest means. Cranially, White South Africans also displayed the largest measurement means for all variables, except inter- and bi-orbital, nasal and minimum frontal breadths, for which the measurements were the smallest of all three groups. For both crania



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and postcrania, Colored South Africans had either the smallest or intermediate measurement means. A series of multivariate subsets were created to present numerous different measurement combinations and achieved accuracies that ranged from 85% to 91% (using LDA), with only one to two misclassifications for White South Africans, creating almost complete separation of the group from Black and Colored South Africans. Overall, White South Africans had the highest correct classification rates, followed by Black and Colored South Africans, respectively.

Substantial heterogeneity among the three South African groups decreases the positive predictive power of the cranial and postcranial methods, making them of limited reliability in a forensic setting. The current research demonstrates that when used in combination, cranial and postcranial measurements have the potential to outperform the current standard methods for estimating ancestry in South Africa.² Combining the skeletal elements accounts for more between-group variation and decreases the amount of overlap observed among Black, Colored, and White South Africans, ultimately yielding improved accuracies. Using a computer program, such as FORDISC[®] 3.1, that combines or selects the most discriminatory variables on a case-specific basis, may be the best approach to ancestry estimation.

Reference(s):

1. Liebenberg L., L'Abbé E.N., Stull K.E. Population differences in the postcrania of modern South Africans and the implications for ancestry estimation. *Forensic Sci Int.* 2015;257:522–9.
2. L'Abbé E.N., Kenyhercz M.W., Stull K.E., Ousley S.D. Craniometric Assessment of Modern 20th-Century Black, White, and “Colored” South Africans. *Proceedings of the American Academy of Forensic Sciences, 65th Annual Scientific Meeting, Washington, DC.* 2013. p. 444.

Classification Models, LDA, Human Variation