## A5     An Estimation of American Black and White Ancestry From Measurements of the Vertebrae and Sacrum

*Rhian Dunn, MS\*, Erie, PA 16503; Luis L. Cabo, MS, Mercyhurst University, Erie, PA 16546*

**Learning Overview:** After attending this presentation, attendees will understand the applicability of Ünlütürk's method to an American sample for ancestry estimation.[1]

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by demonstrating the utility for ancestry estimation of the metric measurements of vertebral elements utilized in Ünlütürk's method.[1]

Ancestry estimation is a key element of the biological profile utilized to aid in victim identification from skeletal remains. While the midfacial region has been shown to be the most accurate for ancestry estimation, cranial elements are often missing in forensic contexts. Thus, it is necessary to consider and validate ancestry estimation methods based on the postcranial skeleton, in terms of *Daubert* compliance. Currently, metric methods for the postcranial skeleton are relatively scarce. The most common metric tool for metric ancestry assessments, FORDISC®, uses linear discriminant function analysis to classify the unknown individual. But, while it includes 13 reference groups for the cranium, it only offers two ancestral groups for the postcranium, highlighting the disparity between the attentions traditionally paid to the two body regions in this sense. Some additional studies have looked into characteristics such as the anterior femoral curvature, which, as measured, was shown not to correlate strongly with ancestry, or measurements of the pelvic girdle, but the infrequent explorations of postcranial elements as an alternative to cranial ancestry assessment have also lacked validation studies.[2,3] The vertebral column has been studied for sex estimation, positive identification, age estimation, and stature, but its potential utility for ancestry estimation has received less attention, with the exception of Ünlütürk's studies. Ünlütürk defined a series of measurements and used them to extract sex-specific discriminant functions to classify Black and White South African individuals from the Pretoria Skeletal Collection. Ünlütürk's functions covered different vertebral and sacral combinations, not requiring the full vertebral column, and rendered classification accuracies up to 98.5%, suggesting a high potential for its forensic utility. The primary purpose of this study was to validate the use of Ünlütürk's method on an American sample. The ultimate goal was determining whether the method could be useful in American forensic settings, with or without modification of Ünlütürk's original equations.

A total sample of 251 individuals (with balanced sex and ancestry) from the Hamann-Todd Collection at the Cleveland Museum of Natural History were measured according to Ünlütürk's descriptions. An early 20th-century collection was selected because social constructs at the time the collection was started (i.e., segregation) may mimic social constructs at play when the Pretoria Collection was started (i.e., the apartheid), both potentially resulting in artificially inflated group differences due to reduced admixture and subjective removal or labelling of mixed or unclear individuals. Four of Ünlütürk's original ten functions were tested first in their corresponding sex equations (i.e., male dimensions were entered only in male equations), then in the pooled-sex equations in order to determine the need for sex-specific functions. Goodness-of-fit tests were used to assess whether the obtained accuracies departed from the null, random classification models, as well as to test for between-sex and between-ancestry accuracy differences, as the measurements in the original study had not been tested for specific differences between groups, and so classification in that study may have rather been expressing other confounding factors, such as body size.

The obtained classification accuracies in the sex-specific equations were not as high as those reported in Ünlütürk's original study (61%-70% in the American sample compared to the 80%-95% accuracies reported by Ünlütürk). More interestingly, the utilization instead of sex-pooled equations did not reduce accuracy (63%-71%), indicating that sex-specific equations may not be necessary in this method. The results of the goodness-of-fit tests strongly supported the same hypothesis, as all detected differences were related to ancestry ($p < 0.001$), rather than to sex or to the interaction of sex and ancestry. This indicates that the obtained classifications are based on shape differences across ancestries, rather than on differences in size or on sexual dimorphism. In conclusion, Ünlütürk's method seems to be a valid and useful tool to detect actual ancestry differences, although it likely requires further studies and reference sample expansion to adapt it for a more general use and increase its accuracy in populations other than South African.

**Reference(s):**

1. Ünlütürk O. 2017. Metric assessment of ancestry from the vertebrae in South Africans. *Int J Legal Med* 131:1123-1131.
2. Walensky N.A. 1965. Study of anterior femoral curvature in man. *Anat Rec* 151:559-570.
3. Patriquin M.L., Steyn M., Loth S.R. 2002. Metric assessment of race from the pelvis in South Africans. *For Sci Inter* 127:104-113.

**Ancestry Estimation, Metric Method, Vertebral Column**