A26 A New Statistical Approach to Morphological Sexing of South African Remains

Samuel R. Rennie, BSc, Liverpool John Moores University, Rm 439a James Parsons Bldg, Byrom Street, Liverpool L3 3AF, UNITED KINGDOM; Margaret Clegg, PhD, University College London, Gower Street, London WC1E 6BT, UNITED KINGDOM; and Silvia Gonzalez, PhD, Liverpool John Moores University, Byrom Street, Liverpool, Merseyside L3 3AF, UNITED KINGDOM*

After attending this presentation, attendees will better understand the Summary Sex methodology and how it can be used to assess human remains regardless of population affinity.

This presentation will impact the forensic science community by demonstrating how using the population-specific equations and a universal South African equation makes it possible to estimate sex with a high degree of accuracy.

Anthropologists agree that the most sexually dimorphic element in the human skeleton is the pelvis. This can be explained by the strong selection pressure for bipedality and childbirth; however, when sexing the pelvis, different morphological features can display conflicting results when analyzed separately, so an overall assessment of multiple indicators is generally best. Sadly, in many forensic and archaeological cases, complete remains are rare, and forensic specialists normally have to attempt estimating a biological profile using fragmented remains.

Summary Sex is a multivariate approach to sex estimation that uses a Principal Components Analysis (PCA). This is achieved by analyzing ordinal data collected from up to nine morphological features on the human pelvis. Each of the morphological traits are scored between -2 (hyper-feminine) and +2 (hyper-masculine) with 0 being an ambiguous score. First, only complete remains are analyzed, and a linear equation is created from the first Principal Component (PC). Second, if a specimen is missing any data, the median value for that specimen is calculated and replaces all missing scores. For example, the specimen has five of the nine morphological features present which have the scores of -2, -1, -2, 0, -1, then the remaining four missing scores would have the value of -1. The median was chosen to replace missing values as it follows the amount of sexual dimorphism that is seen in the pelvis and doesn't create a "muddying" effect when plotted.

Two South African samples were created using the modern-day skeletal collections of the Pretoria Bone Collection (housed at the University of Pretoria) and the Raymond Dart Collection (housed at the University of the Witwatersrand). As these are cadaver-based collections, age, sex, and ancestry are known for each individual. South African Whites (N=193) and Blacks (N=204) were analyzed separately to create specific equations for each group. From this, comparisons were made between the two equations and were tested against each other to assess the possibility of different percentage accuracies. A second analysis was performed which pooled the two samples together to form an overall South African sample (N=397) to create a new equation which was compared against the equations created from the population-specific equations.

The Summary Sex equation for the specific groups resulted in 94.82% accuracy for South African Whites and 89.95% for South African Blacks. When comparing results, the South African White equation on the South African Black data resulted in 89.48% accuracy and the South African Black equation on South African White data was 94.82%. When pooling both groups, correct classification of sex was 92.70%. When this overall equation was then applied to only Black or White South Africans, it resulted in accuracies of 89.95% and 94.82%, respectively.

What this methodology shows is that, unlike Discriminant Function Analysis where knowledge is needed *a priori*, a PCA approach has the ability to classify males and females with high accuracy. Also, Summary Sex allows a researcher to observe the range of sexual dimorphism present within a given population. Furthermore, Summary Sex shows the capability of analyzing specimens that are fragmented and still retain a high percentage of accuracy.

Principal Components Analysis, Pelvis, Forensic Anthropology

*Presenting Author