



A74 Sex Estimation Using Metric Measurements of the Sternum

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After attending this presentation, attendees will understand the benefit of including sternal measurements in traditional postcranial metric analyses. By understanding how the sternum can be utilized for sex estimation, an appreciation of how all bones contribute to constructing a biological profile will be gained.

This presentation will impact the forensic science community by presenting testable metric measurements of the sternum that display a high degree of differentiation between the sexes.

Though the innominate is most commonly used for skeletal sex estimation, post-cranial measurements have also proven to be accurate and useful due to the fragile nature of the pubis. Due to the incomplete or fragmentary nature of forensic cases, the need to use any available bones to produce a more accurate biological assessment of the individual cannot be overstated. Work by Jit et al. using Indian sternums produced a 84.9% classification accuracy for males and 88.6% accuracy in females.¹ Dahiphale's 2002 validation study of Jit et al. further demonstrated the feasibility of this method with classification accuracies of 92% for males and 87% for females.²

This study used metric measurements on sterna from an American group of Blacks and Whites from the Hamann-Todd Collection for use in sex estimation. A total of 152 individuals were used, with 76 males and females, respectively. Six measurements were taken to the nearest millimeter from the manubrium and sternal body using digital sliding calipers. Data was then analyzed using the statistical program R and FORDISC®.^{3,4} All accuracy rates were evaluated using discriminant function leave-one-out cross-validation. Measurements were analyzed individually, together, and using forward stepwise selection to classify an individual based on the best measurements available. All functions were tested for within-group variance-covariance matrix homogeneity, a requirement for linear functions, using the Kullback test. A forward mean stepwise analysis was also run to produce a cross-validated classification for ancestry, as well as for ancestry and sex combined.

The Kullback test *p*-value was greater than 0.01 for all analysis, meaning the hypothesis that the variation in each group is more or less the same was accepted. Each measurement alone classifies individuals by sex at a rate higher than 80% with the exception of breadth of the third sternal body and breadth of the last costal notch. The best function for sex classification was the four variable forward mean stepwise selection function (Breadth of First Costal Notch (-0.383))+Height of the Sternal Body (-0.174)+Maximum Manubrium Height(-0.161)+Breadth of the Manubrium(-0.048)+38 which showed a 91% sex classification accuracy. When the value is greater than zero, the individual is classified as female; if less than zero, the individual is classified as male.

Discriminant function analysis for ancestry using forward mean stepwise chose three measurements with an accuracy rate of 50.9% for females, not better than random; however, the ancestry samples used in this study had different proportions of males and females in each ancestry group. Discriminant function analysis for males needed only two variables in the forward mean stepwise function to produce a classification rate of 64.9%. When the classification of groups by sex and ancestry was run using stepwise, 58.5% of the total sample were classified correctly, suggesting that the sternum shows no metric differences based on ancestry.

This study proves the utility associated with sternum measurements in American groups. By displaying the effective classification by sex, it is the hope that future steps can be made to include the sternum in postcranial measurements.

References:

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3. R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/>.
4. Jantz R.L. Ousley S.D.(2010) FORDISC® 3: *Computerized Forensic Discriminant Functions*. Version 3.1. University of Tennessee, Knoxville, TN.

Sternum, Sex Estimation, Postcranial Measurement