H19 Stature Estimation Based on Dimensions of the Bony Pelvis and Proximal Femur

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After attending this presentation, attendees will gain an awareness and appreciation for the advantages and limitations of using measurements of the pelvic region to estimate stature in mass disaster and burned remains cases where more commonly used bones are not preserved.

This presentation will impact the forensic community and/or humanity by providing ancestry and sex specific stature estimation formulae based on standardized dimensions of the pelvic region that can be applied to mass disaster and burned remains cases.

Inspired by a study that examined the use of sacral and coccygeal dimensions recorded from radiographs to predict living stature, this paper evaluates the validity of using sacral height (SH) measured on dry bone for estimating stature in mass disaster and burned remains cases. The authors also extend this examination to include hip height (HH) and femur head diameter (FHD) because these components are often preserved in mass disaster and burn cases. The affect of sex and ancestry on stature estimation using these dimensions are investigated and group specific regression equations for estimating living stature are provided.

Stature, SH, HH, and FHD were obtained from the Forensic Data Bank on over 260 Black and White males and females of known forensic or cadaver stature. All measures show a significant positive correlation with stature, except SH in White females. There were significant sex and ancestry differences in the variables, but no significant sex and stature or race and stature interactions exist for any of the variables. However, in general, pelvic region dimensions correlate better with stature in American Blacks than they do in Whites. The validity of the regression functions was evaluated using the squared correlation (r^2) and mean squared error (MSE). For males, HH is the best single variable for predicting stature (Blacks: $r^2 = 0.47$, MSE = 31.72; Whites: $r^2 = 0.26$, MSE = 46.99) and SH the worst (Blacks: $r^2 = 0.19$, MSE = 48.07; Whites $r^2 = 0.15$; MSE = 51.64). Among females, FHD is the best single variable (Blacks: $r^2 = 0.32$, MSE = 45.83; Whites: $r^2 = 0.18$, MSE = 45.18) followed by HH (Blacks: $r^2 = 0.35$, MSE = 31.72; Whites: $r^2 = 0.09$, MSE = 54.00) and then SH (Blacks: $r^2 = 0.16$, MSE = 50.58; Whites: $r^2 = -0.003$, MSE = 56.87).

In this study, multivariate equations out-preformed univariate models for all groups. A MAXR procedure was used to find the best twoand three-variable equations. The best two-variable models include HH and FHD for all groups, except White males. The best two-variable functions are 84.23 + 0.338*HH + 0.432*FHD ($r^2 = 0.53$, MSE = 29.42) for Black males, 99.46 + 0.166*SH + 0.267*HH ($r^2 = 0.28$, MSE = 43.95) for White males, 45.73 + 0.206*HH + 1.89*FHD ($r^2 = 0.58$, MSE = 27.44) for Black females, and 95.94 + 0.069*HH + 1.266*FHD ($r^2 = 0.17$, MSE = 50.88) for White females. The addition of the third variable does not increase the correlation except in Black females. The best three-variable equations for predicting stature for Black females is 44. 40 + 0.106*SH + 0.178*HH + 1.792*FHD (r = 0.60, MSE = 26.77).

The results demonstrate that dimensions of the pelvic region can be used to estimate stature with moderate accuracy. Dimensions of the pelvic region are a poorer predictor of stature than long bone lengths, but they perform as well as ankle bone, metacarpal, skull, or bone fragment dimensions previously examined for use in mass disasters. This study also shows that there are considerable differences in the accuracy based on ancestry, with HH, SH, and FHD predicting stature more reliably in American Blacks than for American Whites. Stature estimation in White females based on pelvic dimensions should be avoided due to the low correlation and high MSE. Sacral height alone is a fairly poor predictor of stature, especially in American Whites, with the error ranging from about 7.0 to 7.5 cm. However, the precision of using SH measured from dry bone to estimate stature in males is nearly equivalent to that using SH determined from radiographs.

Forensic Anthropology, Stature, Mass Disaster

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