A4 Estimation of Age From the Adult Pelvis: A Comparison Across Different Pelvic Sites and Statistical Methods

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After attending this presentation, attendees will understand how reliable the estimated age is from three separate pelvic sites compared to one another and why the statistical methods employed in these aging techniques influences the estimates' reliability.

This presentation will impact the forensic science community by demonstrating which of the pelvic aging methods is most reliable and what future research is necessary to improve age estimation for constructing a biological profile.

Age estimation from skeletal remains is a crucial component for generating a biological profile, the use of which assists in the identification of an individual. Bony changes at three pelvic sites (the pubic symphysis, auricular surface, and acetabulum) have been shown to correlate with aging. There have been multiple studies testing the reliability of the pubic symphysis and the auricular surface and comparing those two sites, but few assess the acetabulum and none compare the reliability across all three sites.

Four aging methods were compared in this study: (1) the Suchey-Brooks pubic symphysis method; (2) the Osborne et al. auricular surface method; (3) the Rissech et al. method for the acetabulum; and, (4) the Calce method for the acetabulum.[1-4] The Suchey-Brooks method was selected because it is one of the most frequently used in biological profiling. The Osborne et al. method was used because it provides more discrete age ranges than other auricular methods. Two acetabular methods (Rissech and Calce) were applied because age estimation techniques have recently been developed for this region and all require additional testing.

A total of 212 known-age individuals housed at the Bass Donated Skeletal Collection were examined. The sample was comprised of individuals of European ancestry who died in the United States during the mid- to late-20th century. The study sample ranged from 26 to 95 years of age, with a mean age-at-death of 62 years. Although the sample was selected to be representative across the decades of life, the age distribution was not normal (Shapiro-Wilk W test $p=0.013$, Skew=-0.203).

The reliability of the four methods was assessed by comparing the accuracy (percentage of point age estimates that fall into the predicted age range of a method), inaccuracy (average absolute difference between known and estimated ages), and bias (amount age is over- or underestimated) of the age estimates produced by each method. These data demonstrate which method(s) were most reliable, in what contexts, and therefore, most useful for describing skeletal remains.

In terms of accuracy, the acetabular aging methods represented the most and least accurate of the techniques (96% Rissech and 59% Calce). The Osborne et al. method had 86% accuracy and Suchey-Brooks 64% accuracy. The Rissech et al. method had the smallest margin of inaccuracy (±9 years), followed by Calce (±13 years), Osborne et al. (±16 years), and then Suchey-Brooks (±19 years). Bias tests revealed the tendency for all the methods to underage individuals. The Rissech et al. method only slightly underestimated age (-0.70 years), followed by Calce (-5 years), Osborne et al. (-14 years), and finally Suchey-Brooks (-19 years).

The reliability of the individual methods varied as a consequence of the statistical techniques they employed. Regression-based aging methods are prone to producing estimates biased in the direction of the known age of the reference sample because the predicted ages are set by the mortality distribution of the reference population, which may not be comparable to other populations. Bayesian estimation avoids that tendency because it calculates both the mortality distribution of the reference sample and the test sample's age estimates. Rissech et al., the only method to employ Bayesian estimation, had the most reliable results because it was the most accurate method applied, with the smallest margin of inaccuracy and bias. The results suggest that Bayesian prediction may improve age estimation significantly and following further assessment should be applied to other age indicators.

References:

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