



## Physical Anthropology Section – 2011

### H23 Error and Uncertainty in Pelvic Age Estimation Part II: Younger vs. Older Adult Females

Allysha P. Winburn, MA\*, and Carrie A. Brown, MA, Joint POW/MIA Acct Command, Central Identification Lab, 310 Worcester Avenue, Building 45, Hickam AFB, HI 96853

After attending this presentation, attendees will understand how the error rates of three commonly used pelvic age estimation methods differ among females of different age groups, and how to quantify uncertainty in forensic anthropological analysis. Additionally, error rates will be compared for males and females.

This presentation will impact the forensic science community by responding to Recommendation 3, of the National Academy of Sciences Report, “*Strengthening Forensic Science in the United States: A Path Forward*,” which calls for research determining causes of bias and work toward quantification of method error in forensic investigations.

This presentation is the second half of an aging study designed to test the assumption that adult skeletal age estimation methods have lower error rates when applied to younger versus older adults. It will focus on pelvic age estimation methods for adult females; the first part of the study concerning adult males was presented at the 2010 AAFS meeting.

Skeletal age estimation methods are widely understood to overage the young and underage the old. This paper supports these assertions by offering quantified measurements of error for three frequently used pelvic age estimation methods, as applied to a large sample of female individuals between the ages of 18 and 101 years. The methods include the following auricular surface and pubic symphyseal techniques: Lovejoy *et al.* (1985); Suchey-Brooks (1990); and Osborne *et al.* (2004).

The study sample was compiled from several sources: female individuals sampled from modern known-age Iberian skeletal collections housed at the Universidad de Valladolid and the Universidad Autònoma de Barcelona; and identified female individuals from the Forensic Data Bank (FDB) courtesy of Dr. Richard Jantz at the University of Tennessee, Knoxville. The combined sample was divided into two broad age categories: “younger” individuals ( $\leq 39$  years) and “older” individuals ( $\geq 40$  years). Error with respect to the methods’ assigned means was analyzed in terms of bias (directionality of error:  $\Sigma[\text{estimated age} - \text{actual age}]/n$ ) and inaccuracy (absolute mean error in years:  $\Sigma|\text{estimated age} - \text{actual age}|/n$ ). Percent of correct age classifications (i.e., the method’s predicted age range included the individual’s actual age) was also calculated.

All three methods have low mean positive biases and mean inaccuracies close to five years for the group of females  $< 39$  years of age. Conversely, all three methods have substantial mean negative biases and mean inaccuracies greater than 17 years for females  $> 40$  years of age. In all three methods, levels of mean bias and inaccuracy were statistically significantly different for the two age groups ( $p \leq 0.001$ ; Student’s *t*-test). Error rates were always greater for older than for younger individuals.

Use of the Suchey-Brooks method resulted in correct classification of 95% of individuals  $\leq 39$  years of age and 76% of individuals  $\geq 40$  years of age. For the Lovejoy *et al.* method, the percent of correctly classified individuals was 49% for individuals  $\leq 39$  years of age and 53% for individuals  $\geq 40$  years of age. The Osborne *et al.* phase modifications resulted in a higher amount of correct classifications than the Lovejoy *et al.* method for both age groups (90% and 71%, respectively). Full ranges of error (in years) for each method for individuals  $\leq 39$  are as follows: Suchey-Brooks (-11 to 31); Lovejoy *et al.* (-9 to 19); Osborne *et al.* (-14.9 to 24.8). For individuals  $\geq 40$ , full ranges of error (in years) are as follows: Suchey-Brooks (-43.8 to 20); Lovejoy *et al.* (-53 to 25); Osborne *et al.* (-48 to 18.9).

As compared to adult males, adult females exhibit higher error rates for all three pelvic age estimation methods. In most instances, females are also more likely to be incorrectly classified than males when using these selected methods. An exception is the Lovejoy *et al.* method applied to individuals over the age of 40, which results in 53% correct classification of females and 30% correct classification of males. The full ranges of error for males and females are similar, though female ranges are always slightly larger.

This study indicates that three widely used pelvic aging techniques estimate age in younger adult females ( $\leq 39$ ) with lower error than older adult females ( $\geq 40$ ), but with higher error for females than males. Auricular surface methods are problematic regardless of age group or sex. Given that error increases with age, modifications of upper phases of the Suchey-Brooks method are warranted (e.g., Berg [2008]). It is important to recognize that there will always be error associated with age estimation and other forensic anthropology methods. Therefore, the focus should now move to understanding and quantifying error so as not to overstate method performance.

#### Adult Female Age Estimation, Pelvis, Error