H93 Evaluating Methods of Age Estimation of Fetal/Neonate Remains From Radiographs Using a Diverse Autopsy Sample

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After attending this presentation, attendees will understand the validity of methodology used to estimate gestational age in human fetal and neonate remains.

This presentation will impact the forensic community by testing methods that estimate the age of human fetal remains and raising issues that may affect the validity of such methodologies.

The purpose of this presentation is to evaluate methods of estimating the age of fetal and neonate remains from radiographs and skeletal remains. Esti- mating the age of unknown remains can be an important step in establishing the identity of a fetus or infant as well as determining viability in homicides or clandestine disposals of remains. Previous studies have established a rela- tively linear relationship between gestational age and body size of a fetus. As a result, methods have generated linear regression equations that predict the age of an individual from the length of long bones. Although several methods exist, they have never been adequately evaluated nor tested on diverse populations.

***Method**:* Measurements were taken of both humerii, femora, and tibiae (when possible) by the first author from x-rays of 137 identified fetuses and young infants radiographed at autopsy from 1995-2006 at the New Mexico Office of the Medical Investigator. The sample included 20 Native Americans, 4 African Americans, 58 White Hispanics, and 55 White non- Hispanics with approximately equal sex distribution. Age represented the number of completed weeks of gestation for fetuses and the total number of weeks gestation plus neonate survival time for infants. The range for this sample was 14-49 weeks. Each radiograph was assessed for proper posi- tioning and long bones were measured to the nearest .005mm. The first and second author remeasured a subset of 30 individuals for intra- and interob- server error tests using pairwise t-tests and the technical error of measurement (TEM). The magnification factor was calculated by radiographing skele- tonized fetal remains and dividing the length of bone in the x-ray image by the length of the dry bone. The larger of the two sides was used for further analyses and the sexes and population groups pooled. Three published standards were tested. Method 1 generates a predictive regression equation from radiograph measurements of a single long bone;[1] Method 2 produces a predictive regression equation from radiograph measurements of the length of a long bone used to first estimate the body length (crown-heel length, CHL) of the individual;[2] and Method 3 utilizes a table for gross measure- ments of each long bone.[3] Age estimated by CHL was assessed from the most common clinically referenced source.[4]

Results: The intra- (p-value = .2355, TEM = .2826) and interobserver (p-value = .1579, TEM = .4610) errors are relatively insignificant, suggesting that the measurements are replicable. Overall, Method 1 performed the best, correctly predicting the age of 72.4% of individuals from the humerus, 75.2% from the femur, and 66.9% from the tibia. Method 2 correctly predicted the age of 64.7% of individuals from the humerus, 71.9% from the femur, and 62.1% from the tibia. Method 3 accurately aged 63.8% of individuals from the humerus, 70.2% from the femur, and 55.3% from the tibia.

Discussion: The two methods predicting age directly from long bone measurements performed better for all three bones than the method predicting age from the estimate of the total length of the body. With the exception of the femur for Method 3, each technique consistently underesti- mated the ages of misclassified individuals. Neither of the two radiographic methods (Methods 1 and 2) had corrected for the magnification factor. Inter- estingly, when the correction for magnification factor is removed, the results improve slightly for these two methods. The practical significance of adjusting for the magnification factor and possible explanations for these results will be discussed.

Conclusion: Before a method can be widely accepted in forensic contexts, its internal and external validity must be rigorously evaluated. While the results of the prior studies suggest that the methods achieved adequate internal validity (i.e. were accurate when applied to the population from which they were developed), the results of this study indicate all three methods have poor external validity (i.e. perform poorly and cannot be gener- alized to other populations). Caution is warranted when using these standards to diverse populations. Additional testing is needed, as are standards that reflect greater population variation.

References:

1 Scheuer JL, Musgrave JH, Evans SP. The estimation of late fetal and perinatal age from limb bone length by linear and logarithmic regression. *Hum Biol* 1980;7:257-65.

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4 Usher R, McLean F. Intrauterine growth of live-born Caucasian infants at sea level: standards obtained from measurements in 7 dimensions of infants born between 25 and 44 weeks of gestation. *J Pediatr* 1969;74:901-10.

Fetal Osteology, Age Estimation, Radiography

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