H39 An Investigation and Critique of the DiGangi et al. (2009) First Rib Aging Method

Sara M. Getz, BS, Mercyhurst College, Department of Applied Forensic Sciences, 501 East 38th Street, Erie, PA 16546*

After attending this presentation, attendees will be familiar with the DiGangi et al. (2009) first rib aging method and will have been presented with a study that investigates and critiques this method.

This presentation will impact the forensic science community by making attendees aware of the pros and cons of this newly developed method and the direction of future aging research in the field of forensic anthropology.

Most commonly used methods of age estimation have several shortfalls. They tend to over-estimate the age of young individuals, under-estimate the age of older individuals, utilize terminal age categories, such as 50+, provide age ranges which are too precise or too wide to be of practical use in a forensic setting, and fail to provide prediction intervals based on an explicit probability. To address these issues, the DiGangi et al. (2009)[1] first rib aging method utilizes transition analysis on features of the first rib previously investigated by Kunos et al. (1999)[2] in the Hamann-Todd collection. The newly developed method was first applied to positively and presumptively identified males of Balkan ancestry collected in the former Yugoslavia (n=470). The application of the method, as described in the original publication, requires only that observers familiarize themselves with descriptions of the traits to be scored and the example photos found in the appendix, score the features of the ribs as described, and refer to the table of posterior densities provided in the article to find the appropriate age prediction range and the point estimate of age. The purpose of this study is to evaluate the performance of this method.

To assess inter- and intra-rater agreement, four graduate students with advanced osteological training scored 113 ribs of white males from the Hamann-Todd collection ranging from 21 to 88 years. Sub-samples of individuals were re-coded from the total sample by each observer to allow for the calculation of intra-observer agreement. The 'irr' package in R.2.10.10 (2009)[3] was used to assess levels of agreement for the costal face, tubercle facet, and combined scores. The data was analyzed using tests for both nominal and ordinal data. Despite the fact that the published 95% probability intervals for each combination of scores range from 35 to 50 years, individuals were only placed into an age range that contained their true age on average 87% of the time. With the exception of four younger adults between 20 and 35 years of age who were problematic for all observers, all individuals incorrectly aged were above 55 years of age.

Due to the large overlap in the age ranges provided for each unique combination of costal face and tubercle facet scores, it is possible for observers to correctly age an individual while having only minimal agreement in their scores for each rib feature. The highest inter-observer values for any agreement statistic (Cohen's Kappa) were 0.74 for the costal face and 0.56 for the tubercle facet. Despite the apparent simplicity of the coding system provided, the use of stages with multiple features and ambiguous descriptions results in high inter-observer error and a method that is generally unreliable. Also, the use of arbitrary stages containing multiple features that may or may not be present as opposed to specific ordinal variants directly violates the fundamental assumptions of transition analysis and is inappropriate.

The discrepancies between the performance of the method as described in the original article and the results of this study may be due in part to genetic differences between the males of Balkan ancestry in the original publication and the American white males of the Hamann-Todd collection used in this study. The definitions provided should also be reviewed and revised as necessary to lower inter-observer error rates to acceptable levels. Also, concentrating on ordinal features that change over time is preferred to using an agglomerated "stage" approach. Despite the disappointing performance of this method for age-at-death estimation, transition analysis and other statistically based methods of age-estimation represent the most promising new frontier for the development of new standards.

Funding for this research was provided by the Faculty-Led Student Research Grant Program at Mercyhurst College.

References:

1. DiGangi EA, Bethard JD, Kimmerle EH, and Konigsberg LW. A New Method for Estimating Age-at Death from the First Rib. *Am J of Phys Anthropol* 2009 138:164-176.
2. Kunos C, Simpson S, Russell K, Hershkovitz I. First rib metamorphosis: its possible utility for human age-at-death estimation. *Am J Phys Anthropol* 1999 110:303–323.
3. R Development Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 2009 http://www.R-project.org.

Age-at-Death Estimation, Transition Analysis, Forensic Anthropology

 ** Presenting Author*