A89   Rethinking Adult Skeletal Age Estimation: An Expanded Approach to Transition Analysis Using Binary Traits

Sara M. Getz, MS*, Penn State University, Dept of Anthropology, 409 Carpenter Bldg, University Park, PA 16802; George R. Milner, PhD, Pennsylvania State University, Dept of Anthropology, 409 Carpenter Bldg, University Park, PA 16802; and Jesper L. Boldsen, PhD, ADBOU, Institute of Forensic Medicine, Lucernemarken 20, 5260 Odense S , DENMARK

After attending this presentation, attendees will understand that potentially useful variation exists in areas of the adult skeleton that are not traditionally used for age estimation.

This presentation will impact the forensic science community by demonstrating that age can be estimated when standard features, such as the sternal ribs, pubic symphyses, and auricular surfaces, are unavailable for analysis.

For more than 100 years, the development of age estimation methods for adult skeletons has been heavily weighted toward portions of the skeleton that experience numerous changes throughout life. Despite repeated testing and revisions of techniques based on the cranium, pelvis, and ribs, problems remain. The most notable of these is ubiquitous age estimation bias that worsens after approximately age 50.

This work, with collected data, is a proof of concept that low-information, binary features can be used to produce age estimates throughout adulthood. Five rounds of preliminary data collection, analysis, and trait revision at the W.M. Bass Donated Skeletal Collection were used to investigate more than 250 trait variants. In each iteration of data collection, traits with strong age-related patterns were retained, while those that provided little to no age information were revised for one or more rounds of analysis before being eliminated if useful age-related patterns failed to emerge. Fifty-three skeletal features were ultimately selected and investigated in a larger sample of individuals from the W.M. Bass Donated Skeletal Collection, the Maxwell Museum Documented Skeletal Collection, the University of Iowa-Stanford Collection, and the J.C.B. Grant Collection. These samples were intentionally chosen to represent as heterogeneous a group as possible within a single, broadly defined ancestry category (European/White). This is because in many forensic situations the most appropriate reference sample for an individual case is impossible to identify. Thus, a conservative, widely applicable method is desirable.

The combined sample of 1,010 individuals (677 males and 333 females) from the four skeletal collections was used to select a suite of features that collectively show age-related change throughout adulthood. These data were then used as a reference sample to estimate age for 350 modern and historic individuals from the Athens, Greece, collection and the St. Bride's crypt collection in London. Estimates generated using several dozen binary features are compared to those produced using the existing Transition Analysis procedure and other commonly used age-estimation methods for the pubic symphysis and auricular surface.[1] The Greek sample demonstrates how the selected traits perform on well-preserved modern remains. Individuals from St. Bride's crypt illustrate how the traits perform on individuals from a population with significantly different diet, activity level, and disease exposure than the reference sample. Because this sample is also less well-preserved than the Athens collection or the reference sample, it is a test of how well the procedure performs under less than optimal conditions, similar to those encountered in forensic settings when skeletal elements are often missing or damaged. The produced maximum likelihood estimates of age collectively exhibit less bias than estimates from other methods, even though no data from the cranial sutures, rib ends, pubic symphyses, or auricular surfaces were used.

                                                                                                                                    *Presenting Author

A wider array of features similar to those used here is currently under investigation by a National Institute of Justice (NIJ) -funded research team using a diverse sample of modern populations from four continents. A reference manual and computer software are also under development as part of the larger project.

Reference(s):

1. Boldsen J.L., Milner G.R., Konigsberg L.W., Wood J.W. (2002). Transition analysis: a new method for estimating age from skeletons. In R.D. Hoppa, J.W. Vaupel (Eds.), *Paleodemography: age distributions from skeletal samples.* (pp. 73-106). Cambridge, UK: Cambridge University Press.

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*Presenting Author