H72 Multifactorial Determination of Age at Death From the Human Skeleton

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This presentation will summarize a new method to combine age at death estimates from four commonly used skeletal indicators. The method is simple, applicable, and robust, and has lower inaccuracy and bias statistics than any of the individual indicators separately.

This presentation will impact the forensic community by introducing forensic anthropologists to a new multifactorial age estimation method that is simple to use and reduces error in age estimation, thereby aiding in the identification of unknown human skeletal remains. This method is also applicable to South African populations.

Accurately estimating the timing of death has been the subject of decades of research, method development, and testing for human osteolo- gists because age determination from the skeleton, whether for an individual or a population, is critical in analyzing and describing human skeletal remains. Anthropologists have been developing age determination methods since the 16th century and continue to test and revise them today. Despite an abundance of research and data, a single method for determining age at death from the human skeleton that is both accurate and precise and that appropriately combines multiple estimation methods, continues to elude oste- ologists.

The purpose of this study is to test and develop an easy, applicable, but valid method for combining individual aging indicators. Four of the most commonly used aging methods—the pubic symphysis, auricular surface, sternal ribs, and cranial sutures—were analyzed, first as individual indicators, and secondly as variables in several multifactorial methods. The study sample consists of 394 individuals (203 males, 191 females) from two different skeletal collections on two continents (230 blacks, 164 whites). Skeletal remains of known age, sex, and ancestry were analyzed at the R.J. Terry Collection housed at the Smithsonian Institution in Washington, D.C., and the Pretoria Bone Collection housed at the University of Pretoria, South Africa.

Summary statistics were calculated for the first three individual indi- cators, including mean age and standard deviation for each phase, the observed age range for each phase, and t-tests between adjacent phases to test for significant differences between means. For all of the individual indi- cators, the percentages of individuals' actual ages falling into the published 95% confidence intervals were calculated. An analysis of covariance (ANCOVA) was used to test for significant sources of variation while holding age constant. Finally, inaccuracy and bias statistics were calculated for each subgroup, collection, and the overall sample, for each method.

Three multifactorial methods were devised and analyzed using inac- curacy and bias statistics as well as the percentage of individuals' actual ages falling within the prediction intervals. The first was the simple average of the means from the four individual indicators. An assessment of the spatial overlap of estimated age ranges ensued. First, the Total Minimum Range was recorded for each individual, followed by the Total Maximum Range.

The final multifactorial method was linear regression. First, an all- groups regression equation was generated for the entire sample. Because of the consistent significance of ancestry in the ANCOVAs, two ancestry- specific regression equations were generated.

Inaccuracy and bias statistics indicate that the pubic symphysis is the best overall individual indicator. The ANCOVA results show that ancestry consistently contributes to variation in all of the individual indicators while holding age constant, although the effects of all variables other than age were negligible in a practical sense. Compared to the individual indicators, inac- curacy was reduced in all of the multifactorial methods. The percentage of individuals' actual ages falling into the predicted age ranges was comparable to most of the individual indicators. Ancestry-specific regression equations had the lowest overall inaccuracy and bias; however, an all-groups regression equation had only a slightly higher inaccuracy with the advantage of increased applicability.

This study has produced a simple, applicable, yet robust method for combining individual age indicators. The accuracy and effectiveness of indi- vidual aging indicators improves when they are combined. Linear regression is the best multifactorial method to use when all four indicators are present; however, the simple average or overlapping ranges can be used when human remains are incomplete. While ancestry influences variation in the aging indicators, the U.S. standards utilized in this study appear to be applicable to South African populations.

Age Estimation, Multifactorial Methods, South Africans