A28 Bone Mineral Density (BMD) as an Indicator of Age at Death in Forensic Anthropology: A Test of DXAGE

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Learning Overview: After attending this presentation, attendees will understand how BMD can be utilized as an age-at-death indicator in forensic anthropological contexts.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating that forensic anthropologists may be able to utilize easily obtainable and quantitative BMD parameters for estimating age at death.

Estimating the age at death of individuals represented only by skeletonized human remains is a fundamental aspect of forensic anthropological casework. Traditionally, forensic anthropologists utilize macroscopic features of the skeleton to arrive at these age-at-death estimates; however, in many instances, the most common age indicators are absent or can only be used to arrive at broad, forensically useless age estimates. In addition, forensic anthropologists have difficulty accurately and precisely estimating age at death in individuals older than 50 years due to variation in the aging process. To rectify these shortcomings, several researchers have proposed that BMD is a useful predictor of age at death in forensic anthropological contexts. Given the well-known relationship between increasing age and decreasing BMD, scholars have hypothesized that age-at-death estimates can be generated from the analysis of BMD. Moreover, BMD data are quantitatively generated from bone densitometry scans and remove issues related to observer subjectivity.

Navega et al. utilized BMD data from femora of 100 individuals drawn from the Coimbra Identified Skeletal Collection in Coimbra, Portugal.[1] Navega and coworkers utilized artificial neural networks and created a user-friendly, web-based interface called DXAGE. DXAGE permits forensic anthropologists to generate age-at-death estimates from one or more BMD variables. A predicted age, as well as a minimum and maximum age-at-death estimate, are also calculated by DXAGE.[1] One of the advantages of a neural network is that it can efficiently model difference response layers, while a major limitation is that the results are not easily interpretable as there is not a direct path from x to y variables as in regular regression. Thus, the purpose of this study was to test DXAGE by utilizing BMD data from the National Health and Nutrition Examination Survey (NHANES).

A subset of NHANES femoral BMD data from 470 females over the age of 20 years was utilized. Using the NHANES BMD data, age was calculated in DXAGE and these predicted ages were compared to the known ages from the NHANES dataset. The mean difference between predicted and actual ages was assessed with the Matched Pair platform in the statistical package JMP 13.1, which compares row-by-row differences between two response columns (i.e., predicted age and actual age) using a paired *t*-test. In addition, comparisons were made within age decades to explore the decades with the greatest difference. Results demonstrate that there is a weak correlation between predicted and actual age (r=0.47). Results also show that there is a significant difference between predicted age and actual age in the overall model (Prob > $|t|$ <.0001; Mean Difference F Ratio 34.82) and show that on average DXAGE under ages individuals by 7 years (Mean Difference = -7.2 years). In the youngest age category (20–29 years), the Mean Difference is 7.47 years. In other words, in this younger age cohort, DXAGE on average over ages by 7.5 years. The age category with the least mean difference is 30–39 (Mean Difference=0.65 years). DXAGE under ages individuals in the remaining age categories: by 5.3 years in the 40–49 age group; by 9.7 years in the 50–59 age group; by 15.45 years in the 60–69 age group; by 24.44 years in the 70–79 age group; and by 23.1 years in the 80+ age group. Overall, this study demonstrates that BMD data may be of use to forensic anthropologists for generating age-at-death estimates.

Reference(s):

1. Navega D., Coelho J.D., Cunha E., Curate F. DXAGE: A New Method for Age At Death Estimation Based on Femoral Bone Mineral Density and Artificial Neural Networks. *Journal of Forensic Sciences*. 2018;63(2):497-503.

Age-At-Death Estimation, Bone Mineral Density, DXAGE