H77 Cross-Sectional Diaphyseal Geometry, Degenerative Joint Disease, and Joint Surface Area in Human Limb Bones: A Comparison of American Whites & Blacks

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The goal of this presentation is to examine the accuracy of skeletal markers of age and occupation through analysis of cross-sectional diaphyseal geometry, degenerative joint disease, and joint surface areas.

This presentation will impact the forensic community and/or humanity by adding to knowledge concerning the creation of a biological profile for an unknown victim that is based upon skeletal analysis.

Aging and physical activity are key variables affecting normal adult bone structure. Marked differences in skeletal rugosity are typically referenced in forensic anthropology cases when determining life history parameters (i.e., age, sex, occupation) necessary to establish a presumptive or positive identification as evinced by variation in (1) diaphyseal size and shape (i.e., a marker of load baring) and (2) degree of degenerative joint disease expression (i.e., DJD; marker of age). While there is no shortage of research that explores how diaphyses and joints structurally change with physical activity and age, far too little research has examined how these variables covary within the same skeletal samples. Studied separately, contradictory results suggest that neither occupation nor age have a consistent effect on long bone remodeling, which possibly leads to the creation of inaccurate biological profiles of unknown individuals. As part of a broader research study examining distinctions between the effects of age and behavior-related changes to joint surfaces by comparing samples disparate in occupation (i.e., mild, moderate, strenuous activity level) *and* age group, this study examines cross-sectional diaphyseal geometry, degenerative joint disease, and joint surface areas of bones of the shoulder, elbow, hip, and knee in African American and European American industrialists from the Robert J. Terry Anatomical Collection and William Bass Donated Collection (N=125 and N=130, respectively) to set baseline data. These data answer the following questions:

- Does the joint lipping associated with DJD increase joint surface area as a functional response to force applied to the joint surface over time (i.e., repetitive physical activity) thus making an individual appear biologically older?
- Are long bone diaphyses more accurate indicators of load history associated with repetitive activity than joint surface areas and the expression of DJD?
- Can individuals with less active lifestyles be differentiated from more active individuals based upon analysis of diaphyseal cross-sections, joint surface areas, and degenerative joint disease?

To answer these questions, the left humerus, radius, ulna, femur, and tibia of each individual were grossly and radiographically examined. Only those individuals with known age at death, weight, and occupation were included in the study sample. Individuals that were immature, underweight/overweight relative to height (i.e., below 42 kg and above 90 kg), or grossly pathological were excluded. The joint surfaces of the shoulder were grossly evaluated for DJD using a 4x hand lens and identified through the presence of lipping, bone spurs, and exostoses, porosity and eburnation using a grade based system. Additionally, joint lipping was scored as either trace, mild, moderate or severe and degree of lipping was measured using sliding calipers (mm). Joint surface areas were determined using Scion Image. Lastly, cross-sectional diaphyseal geometry was evaluated with computed tomographic (CT) scanning and subsequent biomechanical analysis (i.e., each CT image was generated using a 1.5mm thick slice with a 4 second exposure time at 170 MA and 120 kV).

All data were tested for violations for assumptions of parametric tests using the Kolmogorov-Smirnov test. These data were *not* normally distributed. Therefore, test means and standard deviations (z-scores) for each activity variable (DJD, JSA, or CSD) was determined and these data were pooled – data by sample, age and sex – to compare the arm, forearm, thigh, and leg using nonparametric tests (Mann-Whitney U and X^2 analysis of variance). The skeletal samples were also compared using MANCOVA to determine the best predictor of activity (DJD, JSA, CSD, or MSM) within samples and between samples for the upper or lower extremity. Cross-sectional geometries and joint surface contours were evaluated using elliptical Fourier coefficients which computed average distances between groups. Then, the shape-based distances between the groups were examined using principle coordinates analysis (PCO). Physical activity effects were not significantly different between these two samples; though a significant interaction between JSA, lipping, and DJD expression was indicated.

Cross-Sectional Analysis, Degenerative Joint Disease, Occupational Markers

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