A30 The Applicability of Intralimb Indices in the Subadult Biological Profile

Elaine Y. Chu, MA, University of Nevada, Reno, Reno, NV 89557; Kyra E. Stull, PhD, University of Nevada, Reno, Reno, NV 89557*

Learning Overview: After attending this presentation, attendees will understand how differences in skeletal growth through the lens of brachial and crural indices can assist in estimating aspects of the biological profile for subadult skeletal remains.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a new perspective for estimating sex, age, and ancestry at country and subpopulation levels.

Body proportions are often used in areas of biological anthropology that explore modern human origins and human variation. Brachial and crural indices, comparisons of the upper and lower segments of the upper and lower limbs, respectively, have primarily been used to assess latitudinal differences in body size following Allen's and Bergmann's rules. The utility of intra-limb indices have yet to be explored as a tool for forensic skeletal estimation, especially in situations in which limited skeletal elements are recovered. The proximate aim of this study is to explore whether brachial and crural indices can be used to develop methods to estimate age, sex, and ancestry in subadults to facilitate positive identification. The ultimate aim of this study is to quantify the ontogenetic appearance of proportions; currently, all studies have looked at subadults as a homogeneous group rather than a heterogeneous group that experiences an exorbitant amount of skeletal change.

Diaphyseal dimensions were collected from roughly 900 contemporary children between the ages of birth to 20 years from the United States and South Africa. Brachial and crural indices were subsequently calculated using diaphyseal dimensions. Children were represented by four different ancestry groups with largely comparable age distributions: American Indian, Hispanic, White, and Black. Individuals were classified into one of four life history stages: Infant (birth to 3 years), Child (3 to 7 years), Juvenile (7 to 12 years), or Adolescent (12 to 16 years). Long bone lengths were also collected on individuals between 16 and 20 years of age to represent an older sample that is comparable to adults. Kruskal-Wallis tests were conducted to test for differences among mean brachial and crural indices by sex, life history stage, ancestry, and country. When showing statistical significance, a post-hoc Dunn's test was used for pairwise comparisons for a more in-depth analysis. Subsequently, Linear Discriminant Analysis (LDA) was then performed; the sample size was large enough that a training sample with k-fold cross-validation was used to create classification models for each area of the biological profile, then a test sample was used to generate realistic accuracy rates.

Results of the Kruskal-Wallis test revealed statistically significant differences between mean brachial and crural indices based on the life history stage, ancestry, and country. The LDA models produced accuracy rates ranging from 40%–90%, with brachial and crural indices showing the highest prediction accuracy for country, even in the younger ages, and population having the lowest accuracies.

Results demonstrate that proportional differences exist at a country level in early ages and this is in accordance with previous studies that use interlimb indices to evaluate Allen's and Bergmann's rules. While not all accuracy rates are at practically applicable levels, increased sample sizes and more uniform distribution of sub-groups may increase accuracy rates in future analyses. This study provides evidence for the importance of exploring the utility of methods for measuring body size variation that is not commonly used in forensic anthropology.

Intralimb Indices, Growth Patterns, Body Size Variation