A31 Living Body Mass Estimation From Skeletal Elements in Forensic Contexts

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After attending this presentation, attendees will have an understanding of the possible place for body mass estimation in the anthropological biological profile.

This presentation will impact the forensic science community by showing the need to develop new inclusions into the biological profile and to statistically validate novel methods.

Body mass estimation in forensic anthropological contexts has the ability to augment the biological profile by providing information about an additional individualizing characteristic. Methods for estimation of body mass from skeletal elements are common in paleoanthropological and bioarchaeological populations; however, these methods have not been thoroughly tested in modern individuals of known body mass. Despite research on this topic in other bioanthropological contexts, methodological and statistical support for the inclusion of body mass in the traditional biological profile is lacking in the forensic literature. The limited populations on which these estimation equations are based may further limit the forensic applicability of these methods.

Across biological anthropology, body mass estimates are usually calculated from femoral head diameter and bi-iliac breadth. In the case of the femur, a mechanical approach is applied and relies on the idea that a bone will respond and remodel to the forces that the bone undergoes; in this case, the weight force of the individual. The estimation of body mass from bi-iliac breadth relies on the morphometric relationship between volume, density, and weight. The body is conceptualized as a cylinder. In order to estimate the volume of a cylinder, the diameter is needed; in this case, the analogous diameter of the human body is the bi-iliac breadth of the pelvis.

This study compares two commonly used methods for body mass estimation in a documented sample drawn from the William M. Bass Donated Skeletal Collection (n=388) consisting of 154 females and 233 males. The mean age-at-death of the sample was 62. All individuals in the sample are of known forensic body mass which ranged from 36.3kg to 190.5kg. Forensic body mass relies on self-reporting, reporting by next-of-kin, or is ascertained from medical and/or governmental paperwork. Although forensic body mass has inherent biases, forensic body mass is a similar measure to the body mass used in medicolegal death investigations by law enforcement.

Results indicate that the methods of body mass estimation from osteometric distances compare well throughout the range of body masses in the sample. Despite this correlation, osteometric dimensions were poor predictors of forensic body mass in individuals whose body masses were considered underweight or obese ($p>0.05$). The middle ranges of body mass had no statistical difference between the skeletal indicators and the forensic body mass ($p<0.05$). Both of the estimates of body mass from osteometric distances limit the variation in the estimates. When compared to the forensic body mass, both of the osteometric methods artificially skew the estimates toward a central mean while the variation in the forensic body mass is greater and therefore the distribution is wider. The standard deviation for the body mass estimations from the femoral head diameter and bi-iliac breadth are 8.18kg and 7.76kg, respectively, while the forensic body mass has a larger standard deviation of 25.44kg.

Although there is some reliability in the estimation of body mass from skeletal metrics, the use of these methods in modern forensic contexts is cautioned as the range of modern body mass variation could be much greater than in the archaeological populations on which the estimation equations are based. Although the theoretical framework for the estimation of body mass from skeletal elements is accepted in some bioanthropological contexts, the wide variation of body mass that is unique to modern populations confounds forensic applications. Better techniques to estimate body mass from the outliers of the body mass spectrum are needed in order allow its inclusion in forensic contexts.

Body Mass, Biological Profile, Validation