H93 Estimation of Living Body Weight Using Measurements of Anterior Iliac Spine Breadth and Stature

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After attending this presentation, participants will understand the utility of anterior superior iliac spine (ASIS**)** breadth and stature measurements in predicting living body weight from skeletal remains.

This presentation will offer a technique that may facilitate accurate weight prediction in cases of missing or unidentified decedents. Body weight information may serve to enhance search criteria and present a more accurate biological profile.

The purpose of this study is to assess the utility of bi-iliac breadth and stature measurements in weight estimation. The focus of the project is on predicting living body weight of deceased individuals from a skeletal sample of modern Americans.

The primary objective of the forensic anthropologist is to provide information useful in obtaining positive identifications of deceased persons. Standard identification criteria for creating a decedent's biological profile include ancestry, sex, age, and stature, but not body weight. The inclusion of body weight in the biological profile could introduce an additional component to the identification criteria and may serve to augment a search image.

Several attributes of body weight, however, may depreciate its use as a profile characteristic. For example, body weight information is often underreported and may only be reliable from limited records, such as medical documents. Body weight is also subject to drastic fluctuation in short periods of time. In addition, obesity and malnutrition may be factors lending to inconsistent prediction results.

Despite these apparent shortcomings body weight is nevertheless an undeniable aspect of a decedent's identity. The forensic anthropologist must take care to maximize the available information so that the chances of identification are increased. Body weight information may not only assist in creating a more complete biological profile but may also provide insight into other forensic considerations such as body transport, body disposal, and other taphonomic processes (Stubblefield, 2003). What occurs during the postmortem interval may be strictly dependent on the body mass of the decedent.

Few studies pertaining to body weight prediction of modern humans have been carried out. In fact, most literature relevant to the prediction of body weight from skeletal remains is concerned with reconstructing hominid biology. Many paleoanthropological studies involve comparative analyses between modern human and primate remains and the fossilized bones of early humans. Research on the issue of body mass has generated prediction techniques based on both cranial and postcranial measurements. The results of paleoanthropological endeavors have provided us with a few viable options regarding techniques for estimating body weight in modern humans.

This study is comparable to earlier methods established by Ruff (2000) in the estimation of body weight based on measurements of biiliac breadth and stature. Ruff's goals were to examine the feasibility of predicting hominid body mass with the use of multiple regression equations. The body mass estimation equations were derived from 56 sex/population-specific sample means broadly representative of the world's living populations. However, Ruff's data were collected from literature sources dating from 1951 to 1989 and did not include any modern American samples. In order to test the accuracy of the equations, Ruff applied the technique to two very different modern human samples. Included in the sample were New Guinean Karkar Islanders and a group of U.S. Marine Recruits, all of which were young adults. Ruff's results indicated that body weight of modern individuals could be estimated with reasonable accuracy in cases of known stature and bi-iliac breadth.

For the purposes of hominid body mass estimation, Ruff also applies the equations to a sample of Olympic athletes. Ruff bases this rationale on the likelihood that extreme athletes may have a body type more representative of the degree of physical conditioning characteristic of earlier populations. Results revealed only an average 3% prediction error, indicating the body mass equations may be useful in estimating the weight of early hominids.

Although Ruff's results indicate low prediction error when stature is known, the technique may also be useful in situations of estimated stature, as is usually the case in forensic situations. The potential of Ruff's equations for great accuracy makes it worthwhile to test a similar method to on a modern American population of average fitness and various ages. In this study ASIS breadth was substituted for bi-iliac breadth because the relationship between the two measurements in proportion to overall body breadth is not significantly different, and ASIS breadth is easily located and measured in both skeletal remains and living humans. The ASIS technique may serve to facilitate weight estimation when sacrum, both pelves, and at least one long bone are present for an individual.

All data for this project were collected using the William K. Bass Donated Collection at the University of Tennessee, Knoxville. Various measurements were performed on skeletal material from 92 individuals. The individuals chosen for measurement were those in the collection with weight and stature records. The sample consisted of 2 black females, 13 black males, 15 white females, and 62 white males. The age range was between 25 and 84, with 60% over the age of 50. Information obtained from all subjects included age, weight, height, race, sex, ASIS breadth, and maximum lengths of the humerus, tibia, and femur. The sacrum and pelves were rearticulated with the use of a large rubber band so that ASIS breadth could be assessed. All ASIS measurements were taken with spreading calipers to the nearest 0.1 cm. Humeral, tibial, and femoral lengths were established with the use of an osteometric board to the nearest 0.1 cm. Stature calculations were performed for each individual using standard formula based on maximum long bone length (Buikstra and Ubelaker, 1994). Although stature was known for all cases, the process of height calculation was necessary in order to determine the usefulness of body weight equations in forensic circumstances. Stature estimations and ASIS breadth were then inserted into regression equations for estimation of body weight.

The preliminary results of this study are not comparable to Ruff's results. Percent prediction error exhibits a value too high to be considered useful in forensic investigations. Several explanations for these results are possible. The inclusion of estimated stature as opposed to actual stature in the equations decreased prediction accuracy. Certain attributes of the Bass collection may have contributed a high prediction error as well, such as questionable weight records, the ages of the deceased, and the under-representation of women and African Americans in the collection. Additional data on younger adults and equally represented racial typologies are needed in order to more accurately formulate such equations.

[1]Buikstra JE and Ubelaker DH, editors. Standards: For Data Collection From Human Skeletal Remains. ayetteville, Arkansas: Arkansas Archaeological Survey, 1994.

[2]Ruff CB. Body Mass Prediction From Skeletal Frame Size in Elite Athletes. *American Journal of Physical Anthropology*, 2000 (113):507517.

[3]Stubblefield PR. Body Weight Estimation in Forensic Anthropology (abstract). American Academy of Forensic Sciences Annual Meeting Abstract Handbook. #H2: 262-263. Chicago, Illinois. February, 2003.

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