A108 Estimating Body Composition From Stature and Bi-Iliac Breadth in Modern Young Adult United States Populations (NHANES III)

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After attending this presentation, attendees will have a better grasp of the fidelity to estimate total body mass, fat-free mass, and fat mass from stature and bi-iliac breadth in modern United States individuals and human skeletal remains as well as some of the factors that impede the accuracy of body composition estimates using the stature and bi-iliac breadth technique.

This presentation will impact the forensic science community by supplying an accurate method to estimate body composition for use in forensic anthropology and the potential for the inclusion of body composition estimates in the biological profiles of unidentified human remains for use in medicolegal investigation and human identification.

Often estimates using the stature and bi-iliac breadth technique for total body mass are not presented in biological profiles for use in forensic anthropology because: (1) there is a lack of population- and sex-specific equations for modern individuals; and, (2) many studies using existing techniques to estimate body mass of modern individuals with known mass are inaccurate.[1–7] Recently, greater confidence has been demonstrated in estimating total body mass from stature and bi-iliac breadth using modern young adults (20 years to 39 years of age), but only in individuals with health body fat percentages.[8] Thus, a major caveat when employing the stature and bi-iliac breadth method to estimate total body mass in modern individuals is both age and excess body mass that deviates from healthy norms.[3,8,9]

Body composition was estimated using stature and bi-iliac breadth from 5,555 individuals in six population samples, males and females, who self-identified as non-Hispanic United States White, non-Hispanic United States Black, and Mexican American from the Third National Health and Nutrition Examination Survey (NHANES III) 1988–1994.[10] Fat-free mass was estimated using values extracted from bioelectrical impedance analysis.[11] The population samples were segmented into sub-samples representing groups with healthy body fat percentages as recommended by the American Council on Exercise (ACE) and groups with increments of +5%, +10%, +15%, and +20% body fat above the healthy norm.[12-13] Ordinary least squares regression was conducted for each sub-sample (108 total) using total body mass, fat-free mass, and fat mass as the dependent variables, and stature and bi-iliac breadth independent variables.

The general pattern observed in this study is that when estimating total body mass, with increasing body fat percentages beyond ACE standards, the influence of stature decreases while the influence of bi-iliac breadth increases substantially. When estimating fat-free mass, the estimates are approximately the same in terms of the influence of stature and bi-iliac breadth, even when using various body fat percentages. Noticeably, this pattern is more consistent in males than females for all population affinities. The overall interpretation of this trend is that fat-free mass can be more accurately estimated from stature and bi-iliac breadth irrespective of body fat percentage and that the primary signal in body composition estimation using the stature/bi-iliac breadth method is fat-free mass. Additionally, prediction of fat mass appeared to be the least accurate in individuals with healthy body fat ranges, and increasingly more accurate only when body fat percentage was elevated and fat mass made up a greater proportion of total body mass.

Three ways to estimate total body mass in human skeletal remains using stature and bi-iliac breadth are proposed. First, total body mass can be estimated assuming both that the individual is a young adult (20 years to 39 years of age) and with body fat percentage within a healthy range.[8] Second, fat-free mass can be estimated, then various ranges of body fat percentages can be presented to achieve incremental total body mass estimates. Or third, fat-free mass can be estimated, then modeled expectations of fat mass in healthy individuals that coincide with stature and fat-free mass can be predicted.[14–16]

The results of this study continue to support the stature/bi-iliac breadth method as an accurate technique to estimate not only total body mass, but now also body composition components such as fat-free mass and by indirection fat mass; however, most estimations assume the individual is a young adult and has healthy body fat percentage. The method presented provides a new reliable tool to estimate body composition for inclusion in biological profiles to aid to the process of human identification in forensic anthropology and medicolegal investigation.

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Biological Profiles, Body Composition, Body Mass