A115 Body Mass Estimation: Preliminary Equations for the Undocumented South Texas Migrants Using Bayesian Inference

Elaine Y. Chu, BSc, 225 Craddock Avenue, Apartment D, San Marcos, TX 78666; and Kate Spradley, PhD, Texas State University, Dept of Anthropology, 601 University Drive, San Marcos, TX 78666*

After attending this presentation, attendees will understand the intricacies of body mass estimation in forensic anthropology and how using Bayesian inference can result in more representative body mass estimations of deceased undocumented migrants from the United States-Mexico border. The goals of this presentation are to generate body mass estimation equations specifically for undocumented migrants found along the United States-Mexico border using Bayesian inference and data from recent national health surveys as an informed prior and to evaluate the accuracy of the equations.

This presentation will impact the forensic science community by providing a new method that results in more accurate body mass estimations for Hispanic individuals.

Forensic anthropologists establish a biological profile for unidentified human remains to help narrow the number of possible missing persons matches. The inclusion of body mass provides additional information to aid in identification since weight (body mass) is often reported in missing persons reports. Previous research reveals there is a need for population-specific formulas for estimating components of the biological profile.[1,2] This conclusion is particularly true of the four currently established equations for body mass estimation from skeletal remains.[3] Operation Identification (OpID) at Texas State University is an initiative to identify migrants that die crossing the South Texas-Mexico border. The inclusion of body mass to the biological profile of the unidentified migrants can assist in the exclusion of many potential matches suggested for each individual in the National Missing and Unidentified Persons System (NamUs).

Reference data come from the National Health and Nutrition Examination Survey (NHANES) and the Encuesta Nacional de Salud y Nutrición (ENSANUT), which are nation-wide surveys that include anthropometric measurements to evaluate the health of the nation. Previous studies have shown that the Waist-to-Height Ratio (WtHR) is a better indicator of health risks associated with weight regardless of sex and ethnic differences.[4,5] This ratio is calculated by dividing waist circumference by height. Evaluation of the relationship between body mass and WtHR from the two health surveys demonstrates a moderately positive correlation (R=0.5757). The informed prior for this study includes the height, waist circumference, and weight of those who identified as United States-born Hispanics (from NHANES) and Mexican-born natives (from ENSANUT). The individuals used for this study (N=36377) include males (n=15,748) and females (n=20,629) between the ages of 20 to 80 years. Linear regression was used to estimate waist circumference from living bi-iliac breadth and again to generate body mass estimation equations for males and females using the WtHR. To test for accuracy of the equations, inverse calibration was conducted on each known body mass to calculate an expected WtHR. A Mann-Whitney Wilcoxon test revealed that there is no statistically significant difference (p=0.3984) between the mean expected WtHR value from the generated equations and mean observed WtHR value of the reference data. This means that WtHR can be used to accurately estimate body mass with a 95% confidence interval.

Skeletal data came from OpID and included an equal number of positively identified males and females (N=6). Fully stature and bi-iliac breadth were obtained for each individual when available. Stature was estimated using FORDISC® 3.1 when the Fully method could not be used. Waist circumference was estimated from bi-iliac breadth, and a WtHR value was calculated. Body mass estimations were generated using the aforementioned equations. The reported weights of the identified individuals from missing persons reports were compared to the estimated body mass ranges. Only one individual from each sex cohort (33.33%) was accurately estimated for body mass. The low accuracy rate may be due to small sample size, self-reporting error, or the individuals falling on the extreme ends of the body weight spectrum.[1,6]

Although the sample size of identified individuals is small, it represents the only remains that are positively identified with full skeletons and an estimated weight on a missing persons report.

Results demonstrate that given the distribution of body mass represented by NHANES and ENSANUT, the resulting equations produce promising body mass estimations when using a WtHR ratio generated from skeletal height and bi-iliac breadth for the unidentified South Texas migrants, but also demonstrates the limitations for cases of largely overweight and underweight individuals.

Reference(s):

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Bayesian Statistics, Body Mass Estimation, Operation Identification

*Presenting Author