Back to TOC

COMPARISON IN SEGMENT MASS VALUES DETERMINED BY THE DUAL ENERGY X-RAY ABSORPTIOMETRY SCAN METHOD AND THE ZATSIORSKY ANTHROPOMETRIC TABLE CALCULATION METHOD

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INTRODUCTION

Nearly 26% the United States population is over the age of 55, a number that is consistently rising [1]. Unfortunately, adults over 55 years old are more at risk of falling, which can be detrimental to both a person's health and finances. In 2000, the average cost of a hospital visit as a result of a fall injury was $35,000 [2]. Biomechanical research and gait analysis greatly assist in understanding the mechanism of falls. With adequate research and understanding, measures can be taken to reduce risk and prevent falls in older adults. However, the analysis of such biomechanical research is done using anthropometric tables which provide approximations for body segment parameters (BSPs), including mass, center of mass, and radius of gyration of the head, torso, upper arm, lower arm, thigh, and shank. These tables are often derived from young, healthy subjects and are not accurate in applications elderly persons [3].

One of the current standard anthropometric methods, the Zatsiorsky regression models, was derived using gamma scanning on mostly young males [4]. Dual energy x-ray absorptiometry (DXA) is a safe method to obtain in-vivo subject-specific BSPs. This technology is able to determine the differences between bone, muscle, and fat [5], and calculate masses based on assumed densities for each tissue type.

The goal of this study was 2 -fold: (1) investigate age-effects in the thigh BSPs between young and older female adults, and (2) evaluate the accuracy of the Zatsiorsky method compared to the in-vivo DXA measures in the same sample of participants. For brevity purposes, we conducted our analyses on the thigh due to the significant large inertial effects of this segment.

METHODS

Twenty-six normal weight ($18.5 \leq BMI < 25.0$), females were recruited to participate in this study, with 13 each in the young and old (21-39 years old, and 55-70 years old, respectively) age groups. BMI and eligibility were validated for each participant after weight and height were recorded. A full body frontal image for each person was take with the Hologic Discovery DXA System (Hologic, Bedford, MA, USA), and then processed to establish body segments and sub-regions used to calculate BSPs. In the DXA scans, certain bony landmarks defined each body segment (Fig. 1). For the thigh, these boundaries were from the greater trochanter to the center of the knee joint. Between these landmarks, the segment was split into sub-regions that were 2-3 pixels (2.6-3.9 cm) tall.

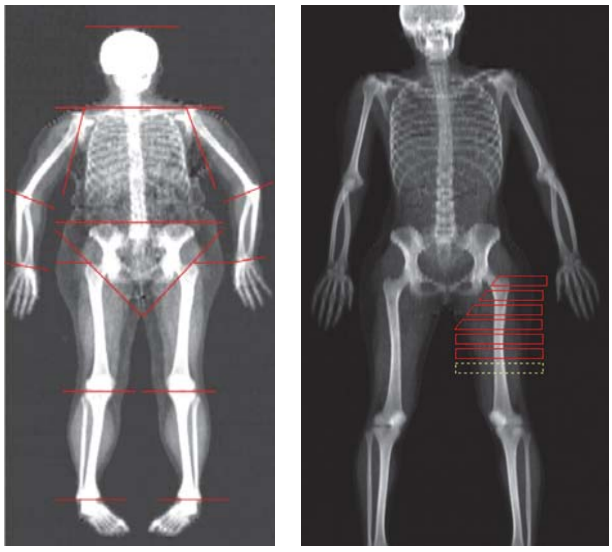

Figure 1: *left:* Full body DXA scan with segment boundaries marked by red lines *right:* sub-regions of the thigh segment indicated with red boxes.

DXA-based measures of the mass of each sub-region were derived and used to calculate BSPs for the entire segment, including the thigh segment mass as a percent of total body mass. The thigh segment mass was also calculated using the Zatsiorsky table of anthropometric values. A mixed linear model was used to analyze the data. More specifically, the outcome variable of interest was the thigh mass (as a percent of total body mass) and the following fixed effects were used in the model: age (young/older), method (DXA/Zatsiorsky) and their interaction. In addition, subject was included as a random effect in the model. Statistical significance was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Both *method ($p < 0.0001$)* and *method x age group ($p = 0.02$)* had a significant effect on the thigh mass assessed as a percent of total body mass (Figure 2). Thigh mass values from the DXA scans were consistently smaller than Zatsiorsky-based values in both the young and old age groups. Post-hoc tukey tests indicate that the difference in thigh mass between the DXA and Zatsiorsky methods were greater in the older group than the younger group *($p < 0.05$).*

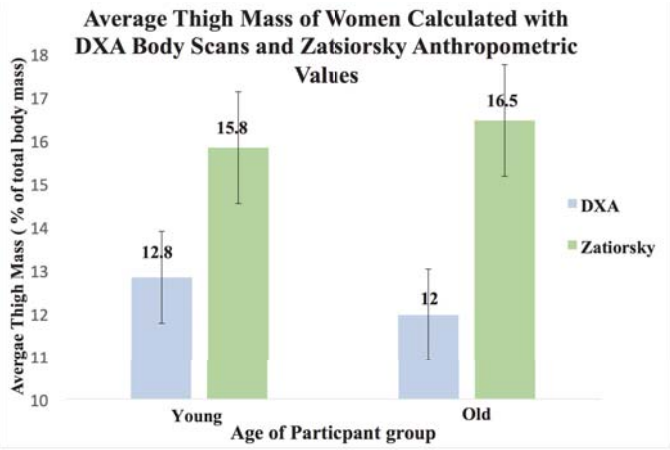

Figure 2: Thigh mass (as a percent of total body mass) comparisons between young and older females determined using in-vivo DXA body scans (blue) and Zatsiorsky anthropometry tables (denoted in green).

CONCLUSIONS

Using the Zatsiorsky model to derive BSPs may be associated with estimation errors when compared to in-vivo measures. We confirmed this finding for the thigh mass in young and older female subjects and the errors were greater in the older group than in the young group. This error may be due to the fact that the Zatsiorsky model was developed using data of healthy, young normal weight adults. This study emphasizes the potential error generated when using generic anthropometric tables for BSP calculations across all ages, genders, and sizes.

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2016 Annual Conference – Raleigh, NC

Welcome to the ASB 2016 Program Website!

ASB 2016 was the 40th annual meeting of the American Society of Biomechanics and it was held in Raleigh, NC from Tuesday, August 2, 2016 to Friday, August 5, 2016.

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