# THE EFFECTS OF GENDER AND OBESITY ON TRUNK INERTIAL PARAMETERS IN OLD AND ELDERLY ADULTS

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## INTRODUCTION

Anthropometry is a necessary aspect of research in the elderly, especially in biomechanics and injury prevention research [1-4]. Typically, body segment parameters are derived from regression equations or models based on cadaveric studies [5] or imaging [6]. A major limitation of these predictive equations is their lack of incorporating gender, age, race or body type [1]. As a result, the use of these parameter estimates has been shown inaccurate in various populations including children [7] and older adults [1]. Unfortunately, there is little inertial anthropometric information available on the elderly [1-3,8-10].

Body segment parameter inaccuracies may be due to gender-specific variations in tissue density within and between body segments as well as age-related redistribution of mass [8]. The effect of obesity may be another reason for the inaccuracies associated with traditional body segment parameter estimations [1,4]. Dual energy x-ray absorptiometry (DXA) has been validated as a reliable in-vivo method to derive body segment parameters that includes tissue density, age, gender and obesity [1,7]. The aim of this study was to report trunk inertial parameters in older adults (aged 65 years and older) and to investigate the impact of aging, gender and obesity.

## METHODS

Eighty-three healthy older adults, screened for metal implants, were divided into 8 subgroups based on gender (Female and Male), obesity determined from body mass index (BMI) (BMI≤30, non-obese and BMI>30, obese) and age (≤75 yrs, old and >75 yrs, elderly). Each participant underwent a whole body DXA scan (Hologic QDR 1000/W) lying supine. For each DXA scan, trunk segment boundaries were identified as the shoulder joint center (estimated as the acromion) and the hip joint center [5,6].

Segment mass as a percent of body mass (SM), segment length as a percent of body height (SL), distance from the center of mass to the proximal end of the segment as a percent of segment length (COM), and frontal plane radius of gyration as a percent of segment length (Rg) were determined [1,7]. These dependent variables were each entered individually in a mixed-factor repeated measures analysis of variance (ANOVA). The independent factors were gender, obesity and age group. Analyses included main effects, two-way and three-way interactions. Post hoc analyses included comparisons using a Student's t-test. Statistical significance was set at 0.05.

## RESULTS AND DISCUSSION

The accuracy of body segment parameters presented here was acceptable and consistent with values reported in the literature [1,6,8-10]. No significant effects were noted in trunk SL. A vertical resolution of 1.30 cm (same resolution as in [7]) may have limited the analysis of SL.

Trunk SM accounted for a significantly greater percent of body mass in obese compared to non-obese individuals (Figure 1). Increases in trunk SM agree with previous literature stating that increased BMI is highly correlated to increases in waist circumference and abdominal fat [2,11,12]. Males had greater SM than females. Males have previously reported with higher trunk segment mass compared to females [8,12]. These gender trends seem to carry into older adults and the elderly. Two-way interaction effects with obesity and age group were also found in trunk SM. In general, obese elderly adults had significantly higher trunk SM than non-obese elderly and all older adults. An increase in factors that would contribute to increased trunk SM has been previously noted with increasing age and obesity [2,9]. It should be of health concern that obese elderly adults have significantly higher trunk SM. Certain waist anthropometry, not just BMI, have been implicated as important predictors of health, obesity and mortality risk in the elderly [2,8].

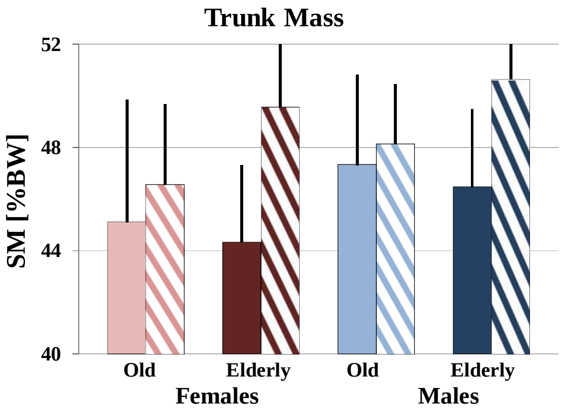


**Figure 1:** Mean trunk SM. Non-obese shown as solid bars and obese as hashed bars. Standard errors are provided.

Gender and obesity effects were also found in COM and Rg. Males had a more proximal trunk COM compared to females (Figure 2). A more distal trunk COM in the female group may seem counterintuitive. However, Okada reported significantly larger mass ratio of the lower trunk and smaller mass ratio of the upper trunk in elderly females compared to males [12]. An increased mass in the lower trunk and less in the upper trunk would translate into a more distal trunk COM in elderly females. Finally, non-obese individuals had a greater trunk Rg than obese. This is interesting since a decrease in Rg was noted in segments with weight loss [4].

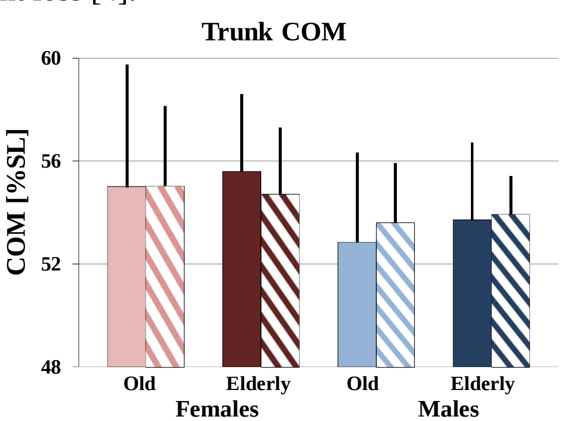


**Figure 2:** Mean trunk COM. Non-obese shown as solid bars and obese as hashed bars. Standard errors are provided.

In general, there is little reported in the literature on the effect of obesity on body segment parameters, especially COM and Rg. However, Durkin & Dowling reported large differences within both young and middle-aged male and female body segment parameters. The authors acknowledge that these variations might be attributed to variations in body type or obesity [1].

## CONCLUSIONS

In conclusion, age, obesity and gender have a significant impact on trunk SM, COM and Rg in older and elderly adults. The data presented here can be used to accurately represent trunk anthropometrics of an aging population. This study underlines the need to consider age, obesity and gender when utilizing anthropometric data sets.

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