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Purpose

The goal of this study was to operationalize a quantitative, gender and BMI-specific assessment of abnormal body composition phenotypes, particularly focusing on sarcopenic obesity in a population-representative sample of White and African American adults.

Background

Sarcopenia, a condition of abnormally low skeletal muscle mass, is associated with several health problems observed with aging such as frailty and physical disability. The growing prevalence of obesity in older adults predicts an increased number of individuals with sarcopenia along with high body fat, a syndrome termed **sarcopenic obesity**, **Figure 1**. Sarcopenic obesity leads to significantly greater morbidity and disability than either sarcopenia or obesity alone. Our understanding of sarcopenic obesity's etiology, consequences and treatment is limited largely due to the lack of a consensus definition and classification for this syndrome.



Figure 1. Image illustrating a sarcopenic obese person. Despite of excess body fat, this person has the same amount of skeletal muscle mass as a cachectic looking, extremely emaciated person would have. Therefore, obesity masks sarcopenia.

Methods

Participants: A population-representative sample from the National Health and Nutrition Examination Survey (NHANES), obtained from 1999-2004 was analyzed for 13236 White, African or Mexican American non-pregnant subjects aged ≥ 18 years.

Body Composition Analysis: Whole body dual energy x-ray absorptiometry (DXA, **Figure 2**) was used. Gender and body mass index (BMI) specific decile groups of height-adjusted appendicular skeletal muscle index (ASMI, kg/m^2) and fat mass index (FMI, kg/m^2) were developed. BMI was used as a categorical variable and defined according to WHO categories.

A four quadrant classification system for the identification sarcopenic obesity, as well as a sub-classification into mild, moderate and severe was used, **Figure 3**. Corresponding deciles were as follows: normal body composition (ASMI: 50-100; FMI: 0-49.99); sarcopenic (ASMI: 0-49.99; FMI: 0-49.99); obese (ASMI: 50-100; FMI: 50-100); sarcopenic obesity (ASMI: 0-49.99; FMI: 50-100). Sarcopenic obese groups were further subdivided into mild (ASMI: 0-49.99; FMI: 50-100), moderate (ASMI: 0-39.99; FMI: 60-100); and severe (ASMI: 0-19.99; FMI: 80-100).

Methods

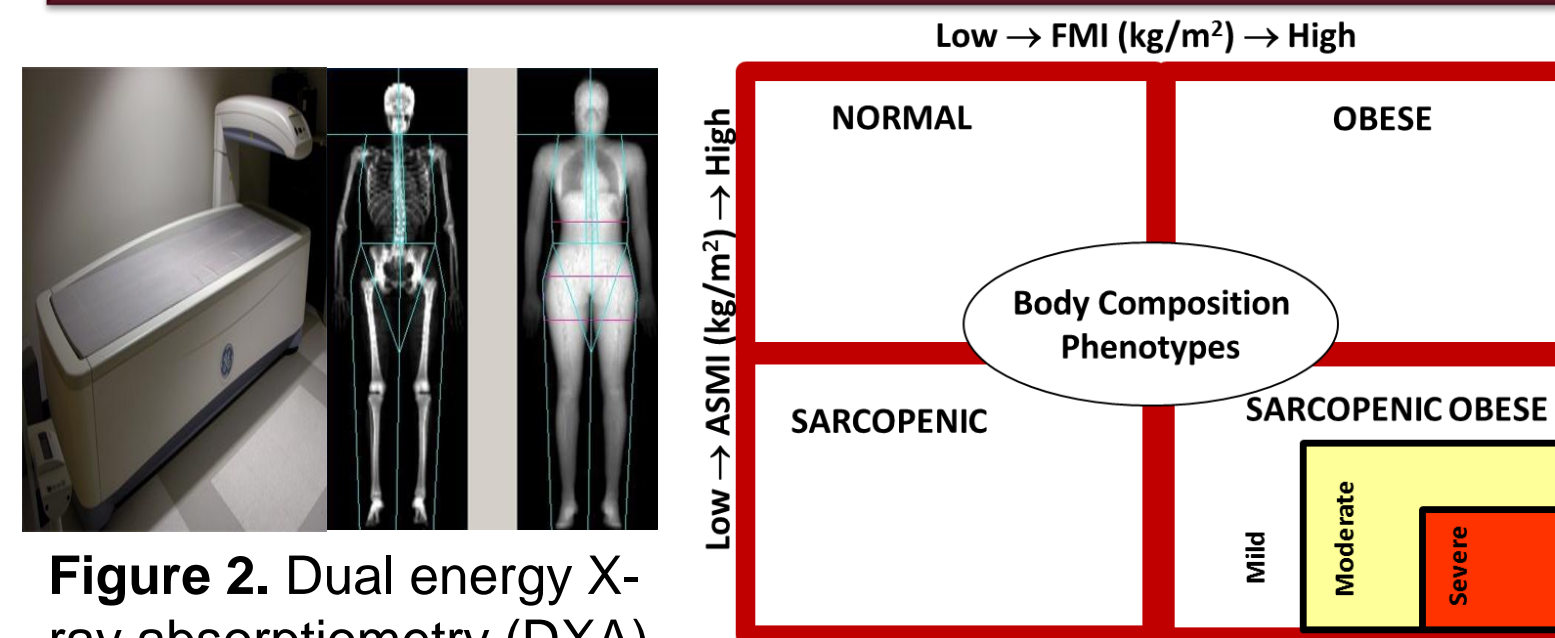


Figure 2. Dual energy X-ray absorptiometry (DXA) technique.

Figure 3. Body composition phenotype classification criteria by decile groups of appendicular skeletal muscle mass index (ASMI) and fat mass index (FMI).

Results

Overall characteristics of study participants are shown in **Table 1**.

The overall prevalence of sarcopenic obesity was greater in men, compared to women (15.2% vs. 10.3%, respectively). As per **Figure 4**, a smaller prevalence of sarcopenic obesity was mostly observed in the obese groups, particularly in obese women. The results showed that the prevalence of severe sarcopenic obesity in obese men is 2.3% compared to 0.3% in women (**Figure 4A, 4B**), which may suggest that obese men may be at greater risk to develop extreme body composition phenotypes.

The prevalence of sarcopenic obesity in normal weight and overweight groups was not negligible. Overall, approximately 23% men and 23% of women with a normal BMI were sarcopenic obese and this increased to approximately 27% and 26% in overweight men and women, respectively (**Figure 4A, 4B**).

Table 1. Demographic characteristics of overall population.

Variables	All	
	Males	Females
N	6210	7026
Age, years	46.93 (0.36)	48.99 (0.38)
Weight, kg	86.98 (0.26)	73.08 (0.40)
Height, cm	177.17 (0.15)	162.87 (0.14)
BMI, kg/m^2	27.69 (0.09)	27.55 (0.16)
FM, kg	25416 (150.88)	30133 (296.81)
FMI, kg/m^2	8.10 (0.05)	11.38 (0.12)
ASM, kg	26472 (78.22)	17374 (72.49)
ASMI, kg/m^2	8.41 (0.03)	6.54 (0.03)
WC, cm	99.96 (0.25)	92.26 (0.45)

Legend: data presented as Mean (SE). BMI = body mass index; FM = fat mass; FMI = FM index; ASM = appendicular skeletal muscle; ASMI = ASM index; WC = waist circumference

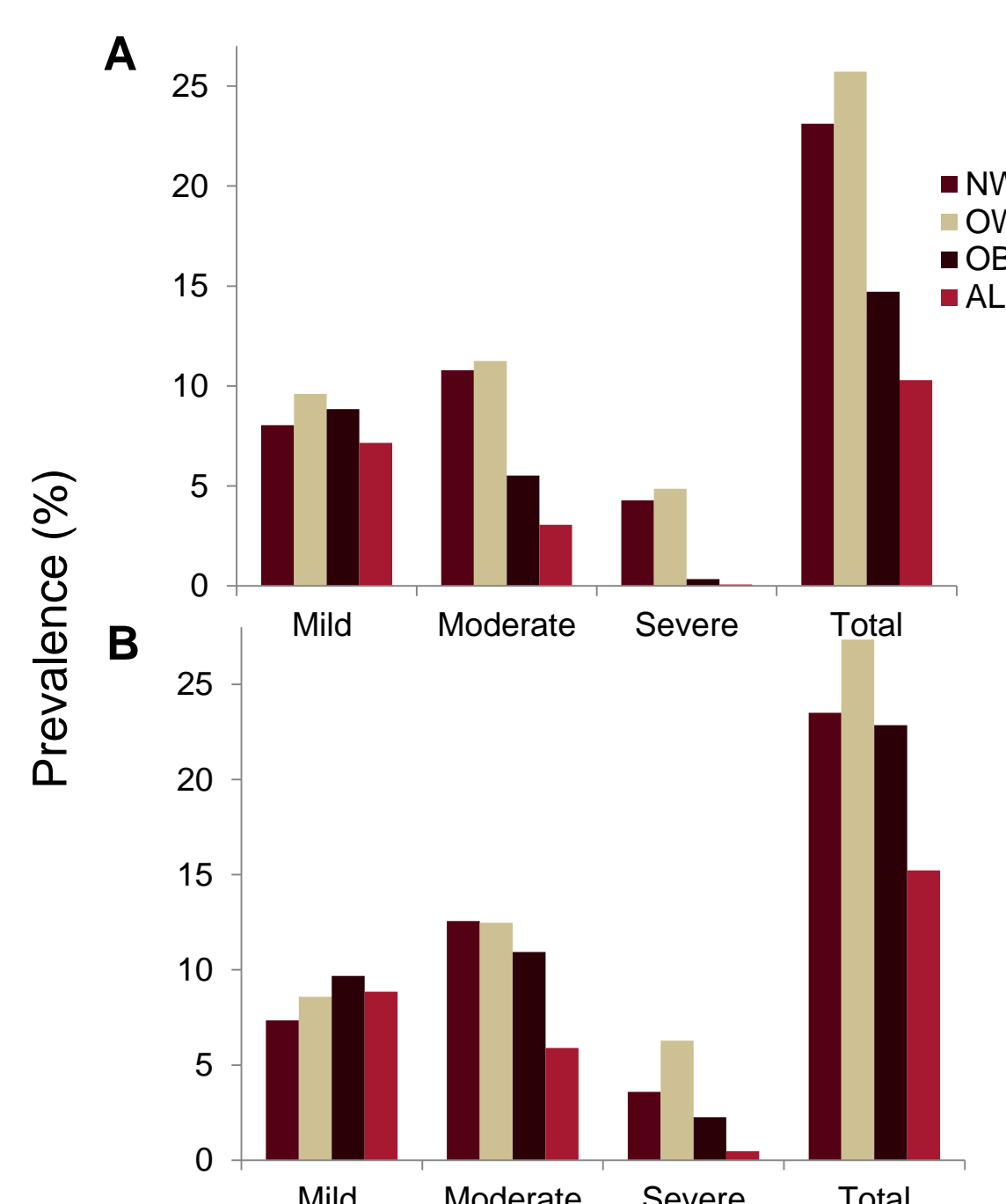


Figure 4. Sarcopenic obesity prevalence rates for **A.** women and **B.** men by BMI category (NW = normal weight; OW = overweight; OB = obese) and overall.

Conclusions

This study is the first to identify the prevalence of sarcopenic obesity in the United States using a nationally representative dataset. From a methodological perspective, this classification system is robust, easy to interpret and clearly describes the various categories of sarcopenic obesity (mild, moderate and severe). Furthermore, it also provides categories and prevalence rates of other abnormal body composition phenotypes (sarcopenia and obesity).

The present results imply notable implications for risk stratification and indicate potential gender-differences in the physiological mechanisms influencing the body composition trajectories for men and women.

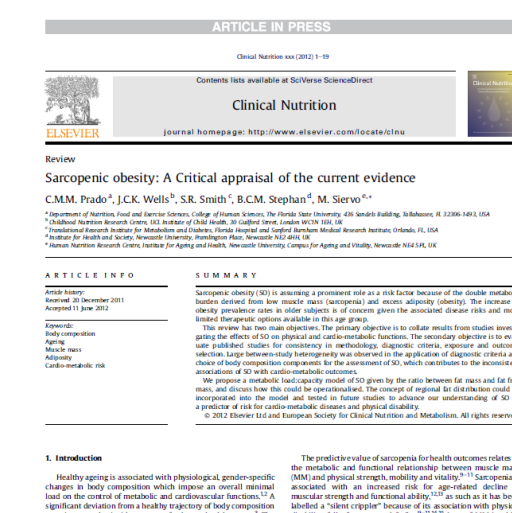
Ongoing Work

We are now in the process of evaluating cardio-metabolic profiles/clinical relevance of each body composition phenotype hereby investigated. Furthermore, we will soon begin to validate our decile curves in population-specific cohorts.

Outcomes

Current & Expected Results of this Work:

- One published peer-reviewed publication;
- Two peer-reviewed publications expected for June, 2013;
- Dr. Prado is currently competing for a Visiting Professorship Award at the Institute for Aging and Health, New Castle University (UK);
- Dr. Prado is currently preparing a multi-country collaborative grant to NIDDK/NIH for continuation of this work.



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