Sarcopenia and Obesity

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KEYWORDS

• Sarcopenia • Obesity • Sarcopenic obesity • Aging

It is now widely accepted that 4 body composition phenotypes exist in older adults: normal, sarcopenic, obese, and a combination of sarcopenic and obese. There is still no consensus, however, on the definitions and classifications of these phenotypes and their etiology and consequences continue to be debated. The lack of standard definitions, particularly for sarcopenia and sarcopenic obesity, creates challenges for determining their prevalence across different populations. It is recognized that the etiology of these phenotypes is multifactorial with complex covariate relationships. This review focuses on the current literature addressing the classification, prevalence, etiology, and correlates of sarcopenia, obesity, and the combination of sarcopenia and obesity referred to in this review as sarcopenic obesity.

DEFINING OBESITY, SARCOPENIA, AND SARCOPENIC OBESITY

Assessing skeletal muscle or fat mass in elders in clinical settings is challenging without the use of precise methods, such as dual energy x-ray absorptiometry (DXA), magnetic resonance spectroscopy, or axial CT scans. As a result, clinical assessments often rely on anthropometric methods that may be subject to substantial misclassification errors. The most widely used clinical measure for assessing obesity is body mass index (BMI).[1,2] BMI is calculated as weight (kg)/height squared (m^2), with adult scores ranging from less than 18.5 (underweight) to greater than 40 (extreme obesity) (**Table 1**).

The BMI cut scores used to define obesity were derived from increases in all-cause mortality associated with a BMI above 30 kg/m^2. The loss of height and lean body mass and increasing fat mass during aging, however, uncouple the relationship between BMI and obesity, thereby attenuating associations with mortality.[2,3] The loss of height results in an overestimation of fatness, whereas a decrease in lean body mass underestimates fatness. Because of this, it has been argued that BMI cut scores are not

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Table 1
Body mass index classifications

Classification	BMI (kg/m^2)	Obesity Class
Underweight	<18.5	
Normal	18.5–24.9	
Overweight	25.0–29.9	I
Obesity	30.0–39.9	II
Extreme obesity	>40	III

Data from National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. Available at: www.nhlbi.nih.gov. Accessed September 17, 2010.

appropriate for an aging population and these changes in height and lean body and fat mass vary not only by age and gender but also by race/ethnic background.[4]

The history of defining sarcopenia has its genesis with Baumgartner and colleagues,[5] who used an approach analogous to the BMI to index relative skeletal muscle mass (SMM). They used appendicular SMM (ASM) from DXA and adjusted for height because of the strong association between height and appendicular lean body mass. The ASM divided by height squared (ASM/m^2) formed a relative skeletal muscle index (RSMI). Using principles similar to defining osteoporosis, low RSMI (sarcopenia) was defined as less than 2 SD from the mean of a young reference population.[6] The resulting cut scores to define sarcopenia were less than 7.26 kg/m^2 for men and less than 5.45 kg/m^2 for women.[5] Lau and colleagues[7] used the same method and developed cut scores for the Asian population. A few years later, Janssen and colleagues[8] developed the second definition of sarcopenia using bioelectrical impedance (BIA) data from a young reference group in the Third National Health and Nutrition Examination Survey (NHANES III). The BIA data were used to predict total SMM. SMM (kg) was expressed 2 ways to create index SMM: (1) as a percentage of total body weight and (2) divided by height squared, similar to RSMI. A criticism of the first index was that the ratio of whole-body SMM divided by body weight is dependent on body fatness and that the variation in body fat is generally greater than that of SMM.[9] The second method resulted in cut scores that were similar to those derived by RSMI, and an SMM index of 5.76 kg/m^2 to 6.75 kg/m^2 was classified as class I sarcopenia and 5.75 kg/m^2 or less as class II sarcopenia in women. Values for men were 8.51 kg/m^2 to 10.75 kg/m^2 for class I and 8.50 kg/m^2 or less as class II. An important addition was that Janssen and associates calibrated these cut scores against prevalent disability using receiver operating characteristic analysis rather than basing them on a reference population. Concurrently, Newman and colleagues[10] proposed a method that used both body height and total body fat to adjust ASM using regression methods. The lowest 20th percentile of the residuals of regression models of body height and total body fat on ASM produced cut scores that provided similar classification to the RSMI.

The European Working Group on Sarcopenia in Older People (EWGSOP) recently published a practical clinical definition and consensus diagnostic criteria for age-related sarcopenia.[11] It was proposed that for a diagnosis of sarcopenia both low muscle mass and low muscle function (either strength or performance) must be present. EWGSOP argued that defining sarcopenia using only muscle mass was too narrow and likely of limited clinical value. This may be a reasonable argument in that the relationship between muscle mass and function is nonlinear. Furthermore, it was also argued that a new term, *dynapenia*, was unwarranted because sarcopenia