



Sarcopenia and sarcopenic obesity classifications and cardiometabolic risks in older women



Enivaldo Pereira dos Santos^{a,b}, André Bonadias Gadelha^{a,c,*}, Marisete Peralta Safons^c, Otávio Toledo Nóbrega^c, Ricardo Jacó Oliveira^c, Ricardo Moreno Lima^{a,c}

^a *Physiology of Exercise and Health Research Group, Faculty of Physical Education of University of Brasília, Campus Darcy Ribeiro, Brasília, Brazil*

^b *Federal Institute of Piauí, Floriano, Brazil*

^c *University of Brasília, Brasília, Brazil*

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ABSTRACT

The purpose of this study was to examine the association between sarcopenia and sarcopenic obesity (SO) with cardiometabolic risk factors in postmenopausal women. 149 volunteers (67.17 ± 6.12 years) underwent body composition assessment using dual energy X-ray absorptiometry (DXA) and had analyzed blood samples collected for lipid profile, glucose metabolism and C-reactive protein (CRP). Sarcopenia was defined as an appendicular fat-free mass (AFFM) divided by height squared $\leq 5.45 \text{ kg/m}^2$ while SO was classified based on the residuals of a regression. Waist circumference (WC) and arterial blood pressure were also measured. Student's *t*-tests and correlations were used for analyses. Prevalence of sarcopenia and SO were respectively 16.8 and 21.5%. WC was significantly correlated with all the examined risk factors. AFFM relative to height squared was positively correlated with systolic blood pressure (SBP) and diastolic blood pressure (DBP), CRP, insulinaemia, HOMA score, and those classified as sarcopenic presented lower HOMA score when compared to nonsarcopenic. Regarding SO, although volunteers classified presented significantly higher fat mass (FM) and lower AFFM, it was not observed association with the examined risk factors. These findings support the association between WC and cardiometabolic risk factors in older women. In contrast, the approaches used to define sarcopenia and SO are not associated with cardiometabolic impairments.

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1. Introduction

The aging process is characterized by a decline in most physiological functions. The decline in both fat-free mass (FFM) and muscle strength (i.e., sarcopenia) is a well documented alteration with advancing age (Rosenberg, 1989). Sarcopenia has been described in both elderly men and women (Baumgartner et al., 1998; Newman et al., 2003; Rosenberg, 1989). It has been linked to multiple negative clinical outcomes (Baumgartner et al., 1998; Lima et al., 2009; Newman et al., 2003) and thus imposes an important economic burden on health care costs (Janssen, Shepard, Katzmarzyk, & Roubenoff, 2004). Further, sarcopenia has also been argued that since women have less muscle mass compared to men,

they may be at higher risk for sarcopenia-related functional limitations and disability (Newman et al., 2003).

There is a lack of clear criteria for sarcopenia identification. DXA has become a practical technique for measuring total body FFM and FM in clinical and research settings (Baumgartner et al., 1998; Gentil, Lima, Oliveira, Pereira, & Reis, 2007; Hu et al., 2012; Lima et al., 2009; Oliveira et al., 2011). Moreover, DXA enables measurements of FFM and FM for the trunk, arms, and legs, and thus has important potential for assessment of age-associated body composition alterations. Baumgartner et al. (1998) identified a cutoff value corresponding to an AFFM divided by height squared equal to or below 5.45 kg/m^2 for women, which was associated with a significantly higher risk of disability in older individuals. Additionally, it should be noted that besides the decline in FFM, older individuals also tend to gain weight, especially FM, as they age (Newman et al., 2003; Oliveira et al., 2011). Therefore, the literature in this area has been focusing on a high FM and low FFM combination (Newman et al., 2003), a condition referred to as SO (Bouchard & Janssen, 2010; Jarosz & Bellar, 2009). SO has been

* Corresponding author at: Universidade de Brasília (UnB), Campus Universitário Darcy Ribeiro, Faculdade de Educação Física, Brasília 70910-900, Distrito Federal, Brazil. Tel.: +55 61 84908490; fax: +55 61 31072500.

E-mail address: andrebonadias@gmail.com (A.B. Gadelha).

associated with poorer physical function (Oliveira et al., 2011), and has been recently examined as an important cause of frailty among older adults (Drouin, Valovich-mcLeod, Shultz, Gansnedler, & Perrin, 2004; Jarosz & Bellar, 2009; Schrage et al., 2007).

Newman et al. (2003) proposed an approach to determine low FFM accounting for FM that has been shown to be associated to functional limitations (Oliveira et al., 2011) and to markers of inflammation (Drouin et al., 2004) in older individuals. However, the importance of determining its association with other health-related outcomes such as metabolic and cardiovascular risk factors has been highlighted. Based on Newman et al. approach, Oliveira et al. (2011) recently proposed a cutoff value for SO classification and observed the ability to detect functional consequences, specifically, reduced muscle strength and aerobic fitness. Furthermore, Dulloo, Jacquet, Solinas, Montani, and Schutz (2010) proposed another index of SO, fat mass index (FMI), which is calculated by dividing total FM by height square. Recent reports have suggested that SO might be linked to increased metabolic and cardiovascular risks (Khamseh, Malek, Aghili, & Emami, 2011; Kim et al., 2010; Srikanthan, Hevener, & Karlamangla, 2010) but further studies are needed to elucidate these questions.

Metabolic and cardiovascular risks are closely related to aging and there is growing interest about the factors that can lead to its related disorders. However, the relationship between these risk factors, sarcopenia and SO has been poorly investigated. In one of the few studies, Lim et al. (2010) demonstrated that SO was more closely associated with metabolic syndrome than either sarcopenia or obesity alone. Conversely, Stephen and Janssen (2009) reported that SO based on muscle mass measures was not associated with increased risks, even though an earlier study had suggested that skeletal muscle is a primary target for insulin action and glucose disposal (Bloesch, Schutz, Breitenstein, Jequier, & Felber, 1988). On the other hand, there is consensus that WC is significantly related to metabolic and cardiovascular indexes in the elderly (Nakamura et al., 2011; Weng et al., 2008). Therefore, the aim of this study was to examine the association between sarcopenia and SO with metabolic and cardiovascular risk factors in postmenopausal women. Based on available literature, we hypothesized that SO would be associated with metabolic and cardiovascular risk factors and that sarcopenia would also be associated, but to a lower degree.

2. Materials and methods

2.1. Study overview

The present cross-sectional study was designed to examine the association between sarcopenia and SO with cardiometabolic risks. To reach this aim, a sample of older women was submitted to body composition assessment through DXA and had blood samples taken for subsequent biochemical measurements. Blood pressure (BP) and WC were also measured. Sarcopenia and SO were identified based on approaches previously described in the literature (Baumgartner et al., 1998; Dulloo et al., 2010; Oliveira et al., 2011) and the risk factors values were compared between individuals classified and nonclassified. Moreover, correlations between sarcopenia and SO indexes with cardiometabolic risk values were also examined.

2.2. Participants

A total of 149 postmenopausal Brazilian women (mean age 67.2 ± 6.1 years old) took part in the present cross-sectional study. Volunteers were recruited through phone calls and visits to centers of leisure and physical activity for elderly people. All participants answered a face to face questionnaire addressing medical history,

medication use and co-morbidities. They also answered the International Physical Activity Questionnaire (IPAQ) short version (Matsudo et al., 2001) to identify physical activity levels. Exclusion criteria used were as follows: metallic prosthesis implants, smoking, metabolic or endocrine disorders known to affect the musculoskeletal system and walk only with assistance.

The study protocol was approved by the Ethics Committee from the University under registration CEP/UCB 108/2011. All participants signed an informed consent form containing the objectives and procedures as well as possible risks and benefits.

2.3. Body composition

Standard procedures were used to measure weight with 0.1 kg precision on a physician's digital balance beam scale, and height was measured at the nearest 0.1 cm with a wall stadiometer. Body mass index (BMI) was derived as body weight divided by height squared (kg/m^2).

Body composition was measured by DXA (Lunar model 8743, GE Medical Systems, USA) according to procedures specified elsewhere (Lima et al., 2009). Besides total FFM and FM, computer-generated lines with subsequent manual adjustment enabled specification of FFM for the arms, legs, and trunk. AFFM was calculated as the sum of both arms and legs FFM. All measurements were carried out by the same trained technician and the equipment was daily calibrated according to the manufacturer specifications. A single individual was scanned for six consecutive days in the equipment and observed coefficients of variation were 0.9% for FFM and 1.9% for FM. Of note, previous reports demonstrate that AFFM is more strongly correlated to whole body muscle mass than is total FFM (Heysmsfield et al., 1990).

2.4. Sarcopenia and SO identification

The classification of sarcopenia was based on an AFFM divided by height squared equal to or below $5.45 \text{ kg}/\text{m}^2$ (female cut-off), as previously proposed by Baumgartner et al. (1998). This approach has been previously applied in Brazilian older women and it has been associated with lower muscle strength, bone mineral density and functional capacity (Lima et al., 2009; Oliveira et al., 2009).

SO was identified in accordance with the specifications recently proposed by Oliveira et al. (2011). Briefly, the method is based on the residual values of a regression equation that predicts AFFM based on height (in meters) and FM (in kg). The equation of elderly people has been identified as follows: predicted AFFM = $-14.529 + (17.989 * \text{height in meters}) + (0.1307 * \text{total FM in kg})$. The residual values (i.e., DXA measured AFFM – equation predicted AFFM) is used for the classification of SO, and the cutoff value corresponds to a residual ≤ 3.4 proposed by Oliveira et al. (2011). In addition, a second measurement of SO was calculated according to Dulloo et al. (2010) specifications. This variable is named FMI and is identified by dividing total FM by height squared.

2.5. Metabolic and cardiovascular risk factors identification

BP was measured twice following five and ten minutes of rest, respectively, using an oscillometric automated device (BP 3AC1-1PC, Microlife, Switzerland). The mean values of SBP and DBP from the two measurements were considered for analyses. WC was measured using an inextensible tape (Sanny Anthropometric Medical) at the midpoint between the last rib and the iliac crest. Blood was collected following overnight fast (12 h). Biological material was immediately moved to laboratory analysis for glucose, CRP, lipid profile, and insulin. In addition, HOMA score was calculated based on the product of insulinaemia ($\mu\text{UI}/\text{mL}$) and

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