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Effects of resistance training on sarcopenic obesity index in older women: A randomized controlled trial

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ABSTRACT

The purpose of this study was to examine the effects of resistance training (RT) on sarcopenic obesity (SO) in older women. 243 older women underwent body composition measurement using dual-energy X-ray absorptiometry, and the SO index was calculated. This randomized controlled trial adopted from the baseline sample, 113 volunteers (67.0 ± 5.2 years) were randomly assigned to a control group (CG, n = 64) or an experimental group (EG, n = 69). The EG took part in a 24-week RT program, conducted three times per week. Body composition measurements were repeated at the end of the training program. RT induced a significant increase in fat-free mass ($P < 0.01$), but not decrease in fat mass in the EG. Moreover, the SO index was also significantly improved in the EG ($P < 0.01$), while it decreased significantly in the CG ($P < 0.01$). It is concluded that RT is an effective approach to promote body composition alterations in older women, and it might improve SO-related phenotypes.

1. Introduction

The aging process is associated with important changes in body composition (Gadelha et al., 2016). Well-documented alterations include a progressive decrease of fat free mass (FFM), particularly skeletal muscle mass (Baumgartner et al., 1998; Waters & Baumgartner, 2011). Rosenberg (1989) denoted this decrease on FFM, strength, and skeletal muscle function as sarcopenia. Sarcopenia has been associated with physical disability (Baumgartner et al., 2004; Cruz-Jentoft et al., 2010) and thus have important health care costs implications (Janssen, Shepard, Katzmarzyk, & Roubenoff, 2004). Another widely recognized change with advancing age is the increase in fat mass (FM), which has been consistently associated with negative health outcomes in the elderly (Bouchard & Janssen, 2010; Lisko et al., 2014; Stenholm et al., 2013). The concomitant increase in FM and decrease in FFM has been referred to as sarcopenic obesity (SO), a condition that has been considered an emerging cause of frailty in older individuals (Bunout, de la Maza, Barrera, Leiva, & Hirsch, 2011; Cruz-Jentoft et al., 2010; Delmonico et al., 2007; Kritchevsky, 2014; Newman et al., 2003; Oliveira et al., 2011). It has been argued that women have less muscle mass and strength compared to men, so they may be at a higher risk for both sarcopenia- and SO-related functional limitations, incidence of falls, and disability (Baumgartner et al., 2004; Bischoff-Ferrari et al., 2015; Bouchard & Janssen, 2010; Cesari et al., 2015; Newman et al., 2003).

Moreover, Newman et al. (2003) proposed an index to examine the relationship between FFM, FM, and height, which was previously associated to skeletal muscle mass, strength, functionality, inflammatory markers, and quality of life (Baumgartner et al., 2004; Cesari et al., 2005, 2015; Delmonico et al., 2007; Jarosz & Bellar, 2009). A recent study conducted by Oliveira et al. (2011) applied this index and observed that it was significantly associated with reduced muscle strength and cardiorespiratory fitness. Given the association between the aforementioned index and negative outcomes, interventions that benefit this measure are meaningful for quality of life in older adults, however, its effects remains to be investigated.

Physical activity in general has been broadly recommended to minimize functional decline in the elderly. Resistance training (RT), in particular, is well known to benefit sarcopenia-related phenotypes (Oliveira et al., 2015; Phu, Boersma, & Duque, 2015), but studies examining its effects on SO have yet to emerge. Literature provides evidence that RT is effective to promote positive body composition alterations in older people. Studies

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conducted in older people observed significant muscle hypertrophy as result of a RT program (Hakkinen, Alen, Kallinen, Newton, & Kraemer, 2000; Porter, 2001), while other studies reported a significant decrease in FM (Kirk et al., 2009). However, results are not consensual (Binder et al., 2005; Silva, Gurjão, Ferreira, Gobbi, & Gobbi, 2006). In addition, no previous study has investigated its effects on the abovementioned SO index. Therefore, the aim of this study was to examine the effects of RT on SO, evaluated using the index proposed by Newman et al. (2003).

2. Methods

2.1. Study overview

A total sample of 243 elderly women underwent body composition measurement by dual-energy X-ray absorptiometry (DXA) to compose a representative regression equation that predicted appendicular FFM. The method is based on the residual values of this equation that considered height and FM. After body composition analyses, a randomized controlled trial was adopted, thus 133 subjects were randomly selected from the total sample, wherein 69 took part in the experimental group (EG) and 64 were examined as a control group (CG). The RT program was composed of 24 weeks, and body composition measurements were repeated at the end of this program. This design allowed to examine the effects of RT on SO in this population.

2.2. Participants

All the participants were resident in the University neighborhood and were invited to participate in the present study by telephone calls. Briefly, one mailing composed of approximately 500 phone numbers was used to prospect women aged between 60 and 80 years, which were called with 300 acceptances. The main reasons for unsuccessful solicitations were phone number alteration, acute illness and lack of interest.

Exclusion criteria were as follows: individuals with any metallic implant or artificial pacemaker, who had undergone hip surgery, who were unable to walk without assistance and those affected by metabolic or endocrine disorders that affect the muscular system. After exclusion criteria were applied, the present analyses were performed with the use of data from the baseline evaluation of 243 older women which joined in a broader project developed in the University. From this baseline sample, 133 subjects (67.0 ± 5.2 years; $28.1 \pm 6.4\,kg/m^2$) were randomly selected, with 69 subjects allocated in the EG and 64 in the CG (Fig. 1). This was a single-blind randomized, controlled 24-week clinical trial in which EG received a progressive resistance training program, meanwhile CG was instructed to maintain their lifestyle routine, with specific attention for nutritional and physical activity habits. Randomization followed baseline assessment and it was conducted by computer-generated list in blocks of 10. The subjects were not engaged in regular exercises for at least 6 months prior to the study. Noteworthy, this study has been registered at clinicaltrials.gov at following identification number: NCT02681744.

Each volunteer answered a questionnaire addressing medical history, hormonal replacement therapy, lifestyle habits, and medication use. After a brief verbal communication covering the objectives, procedures involved, and possible risks and benefits of the study protocol, written informed consent was obtained from each participant before data collection.

2.3. Body composition

Body mass was assessed using a digital scale (Filizola, Brazil), with maximal capacity of 150 kg and 0.05 kg of precision. Height was measured at the nearest 0.1 cm with a wall stadiometer. Body Mass Index (BMI) was calculated by dividing body weight by height squared. In addition, obesity was classified as $BMI \geq 30\,kg/m^2$ (Gadelha et al., 2016).

Body composition evaluations were conducted individually for all 243 participants at the University's Image Laboratory using DXA (Lunar Corporation, EUA) according to procedures described elsewhere (Lima et al., 2009). Briefly, subjects laid face up on the DXA Table with body carefully centered. The software provided data of FFM and FM for whole body as well for specific regions: trunk and appendicular skeleton (upper limbs and lower limbs). The calculation of appendicular FFM consisted in the sum of upper and lower limbs FFM. For those who complied the intervention protocol, body composition measurements were repeated after the training period. All procedures and calibration were conducted strictly according to manufacture 's instructions. Coefficients of

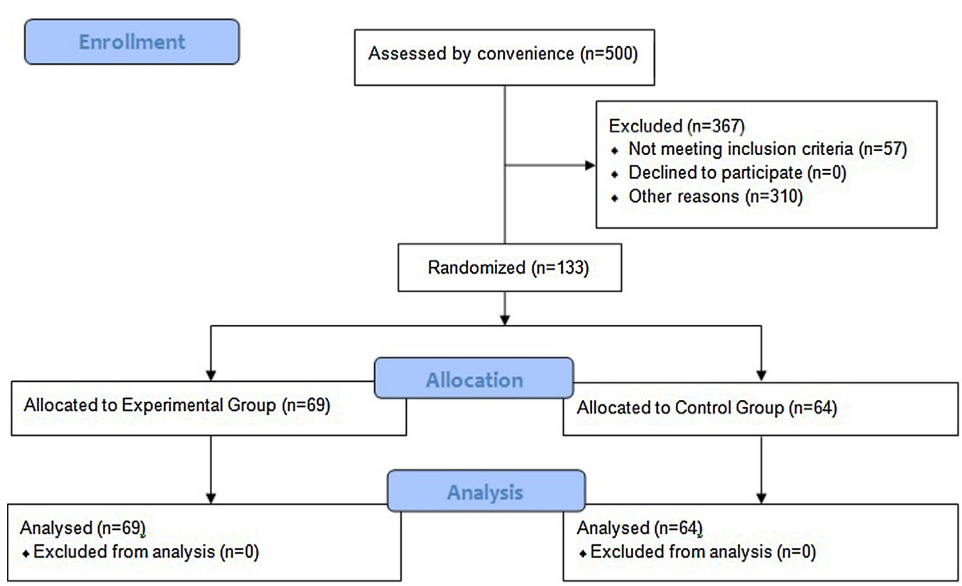

Fig. 1. Flow chart outlining participation in this study.