Experimental Gerontology 60 (2014) 64–71

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

High-speed circuit training vs hypertrophy training to improve physical function in sarcopenic obese adults: A randomized controlled trial

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ARTICLE INFO

Article history:
Received 18 August 2014
Received in revised form 24 September 2014
Accepted 29 September 2014
Available online 1 October 2014

Section Editor: Christiaan Leeuwenburgh

Keywords:
Power training
Resistance training
Elderly

ABSTRACT

Background: Progressive loss of muscle and strength with age is often coincident with increases in adiposity, leading to a condition called sarcopenic obesity. Studies have shown sarcopenic obese adults to be at higher risk for declines in physical function. Despite this rising public health concern, no intervention studies currently exist in this population.
Methods: A total of 21 sarcopenic obese adults, 60 years or older, were randomized into two groups, strength/hypertrophy (SH, n = 9) and high-speed circuit (HSC, n = 8) and were trained for 15 weeks. The primary outcome was the SPPB modified as a measure of physical function, assessed by assessors blinded to randomization. Secondary outcomes were lower body and upper body power and strength, instrumental activities of daily living (IADL), ratings of perceived exertion (RPE), body fat % (BF%), skeletal muscle index (SMI), and grip strength (GRP).
Results: For the SPPB results favored HSC over SH (1.1, 95% CI (−.1 to 2.4), $p = .08$) and showed a moderate effect size (Hedge $g = 0.6$, 95% CI (−0.4, 1.6)). For secondary outcomes, lower body power (mean difference = 158 W, 95% CI (2, 315); $p = .01$) and RPE (mean difference = −1.5, 95% CI (−2.9, −0.12); $p = .04$) also favored HSC. IADL, SMI, BF%, upper and lower body strength and upper body power, showed no statistically significant differences between groups.
Conclusions: Considering the moderate effect size, the large treatment effect shown by the upper limit of the 95% CI, the low perceived exertion, and no adverse effects, HSC training should be further investigated with a larger sample size in sarcopenic obese adults.

It is well-established that aging is accompanied by a progressive decline in skeletal muscle mass and strength (Frontera et al., 2008; Gallagher et al., 2000). The age-related loss of muscle mass and strength characterized by adverse outcomes such as physical disability, falls, poor quality of life and death is termed sarcopenia (Janssen et al., 2004; Lord et al., 1994; Gale et al., 2007). Recently, declines in muscle mass and neuromuscular function have been observed to be coincident with increases in adiposity leading to a condition termed 'sarcopenic obesity' (SO) (Kritchevsky, 2014). Prospective studies have shown obesity to be independently associated with functional decline in the elderly (Koster et al., 2008). Moreover, individuals who are both obese and sarcopenic are more likely to develop functional limitations than non-sarcopenic, non-obese individuals (Rolland et al., 2009). For example, Baumgartner et al. reported that sarcopenic obese (SO) individuals are two to three times more likely to develop disability in instrumental activities of daily living than lean sarcopenic and normal obese subjects (Baumgartner et al., 2004); however, a few studies have found no association between sarcopenic obesity and physical function (Bouchard et al., 2009; Davison et al., 2002). Even though a universal criterion for the diagnosis of SO is lacking, it is apparent that sarcopenia and obesity have independent and additive negative effects on physical function in the elderly. Based on the NHANES 2011–12, more than one-third of older adults aged 65 and over were obese (Ogden et al., 2014). Further, it is estimated that by 2030 there will be 71 million American older adults accounting for roughly 20% of the U.S. population (Vincent and VV, 2010). Despite the rising public health concern, evidence-based interventions targeting SO are conspicuously lacking.

Improving strength and muscle mass by resistance training has been shown to be an effective method for improving physical function in aging individuals (Frontera et al., 1988; Fiatarone et al., 1990); and muscle power has recently emerged as an important determinant of physical function in the aging population. During the aging process, muscle power declines two to three times faster than muscle strength and muscle power has a stronger relation to physical function than muscle strength or muscle mass (Bean et al., 2003; Skelton et al., 1994; Foldvari et al., 2000a). Power training involves moving resistance at higher velocities than traditional strength training and is therefore often termed as high-speed

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http://dx.doi.org/10.1016/j.exger.2014.09.016
0531-5565/

training. Randomized controlled studies have shown that power (high-speed) training may be more beneficial in improving older persons' function than hypertrophy training (Tschopp et al., 2011). In addition, high-speed training has been reported to be less fatiguing than standard strength/hypertrophy programs and recent studies employing high-speed training as an intervention with osteoarthritis and Parkinson's patients demonstrate the feasibility and safety of this training technique (Pelletier et al., 2013; Lima and Rodrigues-de-Paula, 2013).

Recently circuit training, a form of strength training utilizing a repeated sequence of exercises with shorter rest periods than those utilized in typical resistance training, was found to be effective at lowering body fat, increasing muscle mass, and improving functionalcapacity and strength (Romero-Arenas et al., 2013a; Alcaraz et al., 2011). Moreover, circuit training has also been shown to be more effective at lowering body fat than traditional strength training in the aging population (Romero-Arenas et al., 2013b). Because muscle mass may often decline as a consequence of weight loss in SO individuals, an exercise intervention that can simultaneously improve lean body mass and reduce body fat would be an important intervention for this population. Further, high-speed circuit training should be highly effective in treating SO as it can improve power while producing higher levels of energy expenditure than controlled speed lifting (Mazzetti et al., 2011).

Given the paucity of intervention trials targeting SO, we propose a unique exercise intervention for sarcopenic obese individuals. We hypothesize that high-speed circuit training will be more effective than conventional strength/hypertrophy training in improving neuromuscular performance, body composition and IADL function in sarcopenic obese individuals.

1. Methods

1.1. Study design

The study was a 15-week randomized, controlled, single-blind study to determine the effects of high-speed circuit (HSC) training and traditional strength/hypertrophy (SH) training on neuromuscular performance, body composition and IADL function in older persons with sarcopenic obesity. A consort flow diagram of the study is presented in Fig. 1.

1.2. Participants

Participants were recruited from the local South Miami community using flyers, posters, and advertisements in newsletters. We also used an internal database that contained names of older adults interested in participating in research. The eligibility criteria for inclusion were age 60 years or older but less than 90 years and living independently in the community. Exclusion criteria included neurological impairment that would affect balance, severe cognitive impairment (Mini-mental 19 or below), severe musculoskeletal impairment, unstable chronic disease state, major depression, severe vestibular problems, severe orthostatic hypotension, simultaneous use of cardiovascular, psychotropic and antidepressant drugs, and not actively participating in resistance or balance training programs. The respondents, after providing informed consent, were then evaluated for obesity and sarcopenia. Obesity was defined as having a BMI > 30. Sarcopenia was identified using a combination of skeletal muscle index (SMI), gait speed, and grip strength according to the criteria presented in the European Working Group on

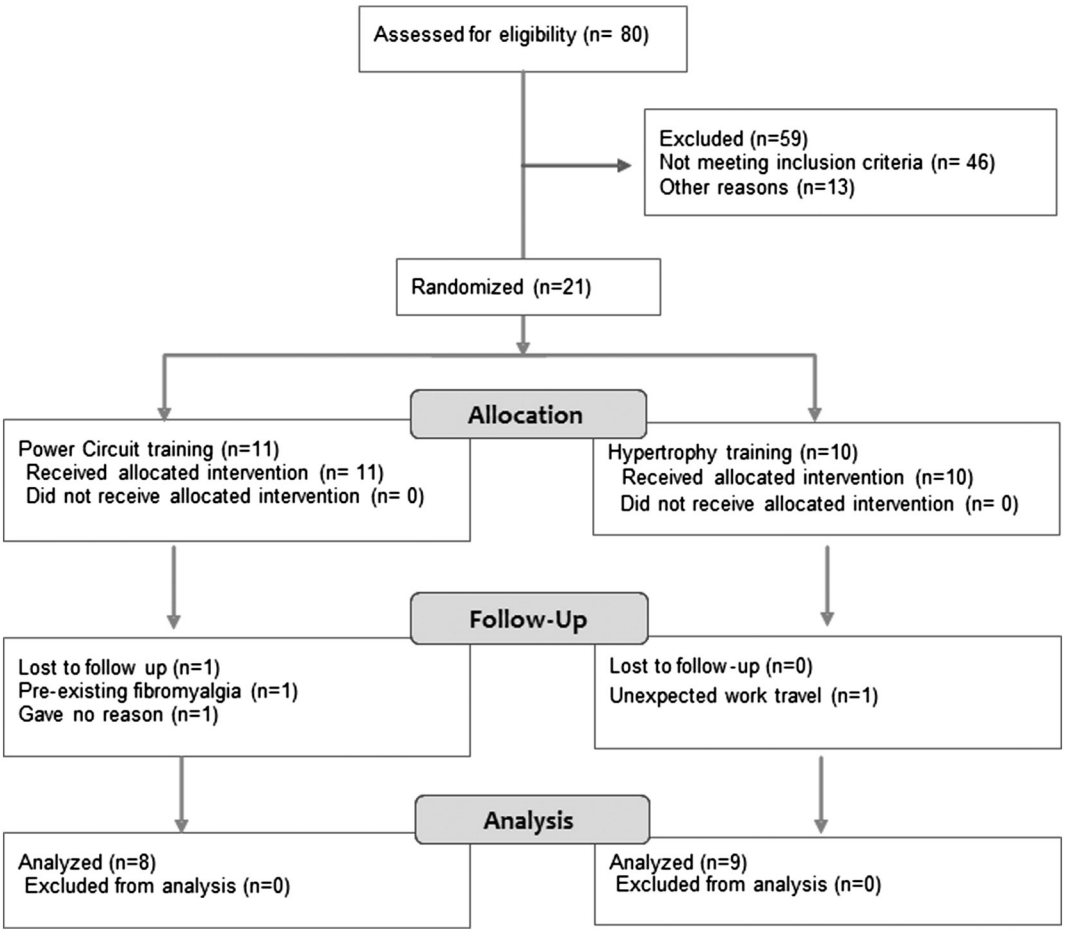

Fig. 1. CONSORT diagram—participant flow through the study.