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High-speed resistance training in elderly women: Effects of cluster training sets on functional performance and quality of life

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ABSTRACT

Objective: To compare the effects of 12 weeks of high-speed resistance training on functional performance and quality of life in elderly women when using either a traditional-set (TS) or a cluster-set (CS) configuration for inter-set rest.

Methods: Three groups of subjects were formed by block-design randomization as follows: (i) control group (CG, $n = 17$; age, 66.5 ± 5.4 years); (ii) 12-week high-speed resistance training group under a CS configuration (CSG, $n = 15$; age, 67.6 ± 5.4 years); and (iii) 12-week high-speed resistance training group under a TS configuration (TSG, $n = 20$; age, 68.0 ± 5.3 years). Training was undertaken three times per week, including high-speed resistance training exercises. The main difference between the training groups was the recovery set structure. In the TSG, women rested for 150 s after each set of eight repetitions, whereas the CSG used an interest rest redistribution, such that after two consecutive repetitions, a 30-s rest was allowed.

Results: Group × test interactions were observed for a 10-m walking speed test, an 8-foot up-and-go test, a sit-to-stand test, and physical quality of life ($p < 0.05$; d = 0.12–0.81). The main results suggest that both training methods improve functional performance and quality of life, however, the CS configuration induced significantly greater improvements in functional performance and quality of life than the TS configuration.

Conclusion: These results should be considered when designing appropriate and better resistance training programs for older adults.

1. Introduction

Functional capacity shows a progressive decline with aging, reaching a reduction of as much as 40% between 60 and 90 years (Rikli and Jones, 2013); this decline might be associated with many factors, such as decreases in muscle mass, strength and power (Byrne et al., 2016). The ability to exert high force at higher velocities show a pronounced and particularly sharp decline with age, with an even more pronounced decline than that in muscle mass and strength (Edwen et al., 2014). This loss of muscle power has been associated with an increased risk of falling and with impairments in quality of life, cognitive function and functional performance (Alcazar et al., 2018; Bean et al., 2002; Martinikorena et al., 2016). Therefore, adopting strategies that aim to preserve or increase muscle power might be of great importance to older people. One common strategy to attain this goal is through high-velocity resistance training (HVRT). In agreement with this suggestion, previous studies have shown that HVRT is able to increase muscle functionality largely than traditional resistance training in older people (Ramirez-Campillo et al., 2014, 2016, 2017).

Notwithstanding its potential benefits, a discussion about the feasibility of HVRT has emerged (Cadore and Izquierdo, 2018; Cadore et al., 2018), and more information is needed on how to implement this type of activity. One possible strategy to perform HVRT in the elderly might be using cluster sets (CS), which involves performing resistance

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training with short breaks between the sets, allowing the performance of the exercise at lower fatigue levels. Previous studies in young men have shown that 8 weeks of training at lower fatigue levels is associated with higher increases in muscle power (Pareja-Blanco et al., 2017), and CS have been shown to acutely improve muscle power when compared to traditional RT (Garcia-Ramos et al., 2015; Haff et al., 2003), as well as after 12 weeks of training (Oliver et al., 2013). However, the effects of CS on functional capacity and quality of life in older people are still unknown. It is important to note that while RT is mainly associated with increases in muscle power, strength and hypertrophy, it can also improve other important health outcomes in the elderly, including functional capacity and quality of life after interventions of between 10 and 12 weeks (Barbalho et al., 2017; Fiatarone et al., 1994; Ramirez-Campillo et al., 2016). Therefore, the aim of the present study was to compare the effects of HVRT performed with CS or following a traditional protocol on functionality and quality of life in older women.

It was hypothesized that high-speed resistance training performed with CS would be associated with greater improvements in functional performance and quality of life in older women than high-speed resistance training completed under a TS configuration.

2. Methods

To compare the effects of 12 weeks of high-speed resistance training on functional performance and quality of life in elderly women using either a TS or a CS configuration, three groups of subjects were randomly formed. A block-design randomization sequence was generated electronically at https://www.randomizer.org and concealed until interventions were assigned. This procedure was established according to the "CONSORT" statement (http://www.consort-statement.org). A graphical description of the randomization process is illustrated in Fig. 1. One group of women was deemed the control group (CG, $n = 17$; age, 66.5 ± 5.4 years; age range, 60–83 years; body mass, 64.0 ± 8.1 kg; height, 147.9 ± 5.3 cm; body mass index 29.4 ± 4.1, kg·m^{-2}; resting heart rate, 74.0 ± 9.7 beats·min^{-1}; systolic blood pressure, 148.4 ± 18.3 mm Hg; diastolic blood pressure, 76.2 ± 9.0 mm Hg). A second group completed a 12-week high-speed resistance training program, with three sets per exercise, under a CS configuration (CSG, $n = 15$; age, 67.6 ± 5.4 years; age range, 61–77 years, body mass, 70.2 ± 9.3 kg; height, 151.7 ± 4.5 cm; body mass index 30.6 ± 4.2 kg·m^{-2}; resting heart rate, 70.2 ± 8.3 beats·min^{-1}; systolic blood pressure, 152.0 ± 15.7 mm Hg; diastolic blood pressure, 78.7 ± 9.1 mm Hg). A third group underwent the same high-speed resistance training program as the CSG but under a TS configuration (TSG, $n = 20$; age, 68.0 ± 5.3 years; age range, 60–78 years; body mass, 64.2 ± 6.8 kg; height, 149.5 ± 5.3 cm; body mass index, 28.8 ± 3.4 kg·m^{-2}; resting heart rate, 71.8 ± 10.0 beats·min^{-1}; systolic blood pressure, 141.8 ± 17.3 mm Hg; diastolic blood pressure, 74.8 ± 8. 7 mm Hg).

2.1. Subjects

Initially, 92 older women of Hispanic descent were considered for participation in the study. Subjects with similar (1276 ± 626 MET/min/week) physical activity levels were recruited, and women from the three groups were periodically asked (i.e., three times per week) to notate their habitual physical activity levels throughout the intervention. Participants met the following inclusion criteria: (a) healthy by self-report (i.e., completion of the revised physical activity readiness questionnaire for older adults); (b) free (by self-report) of a history of heart disease, osteoarthritis, severe visual impairment, neurological disease, pulmonary disease requiring the use of oxygen, uncontrolled hypertension, hip fracture, or lower extremity joint replacement in the past 6 months, and no current participation in structured resistance training exercise or previous participation in resistance training in the past 6 months. Subjects taking medications considered to affect dependent variables (e.g., conjugated estrogen) were excluded from the study. To be included in the final analyses, participants who met the inclusion criteria also needed to complete ≥90% of all training sessions (≥33 of 36 sessions) and attend all assessment sessions. Of the 92 women initially considered for inclusion in the study, 4 were excluded due to a history of heart disease, 4 due to a preexisting diagnosis of osteoarthritis, and 2 due to a history of hip fracture. Additionally, 8 women did not attend all baseline measurement sessions. Therefore, 74 women were finally included and randomly divided into the CG, CSG

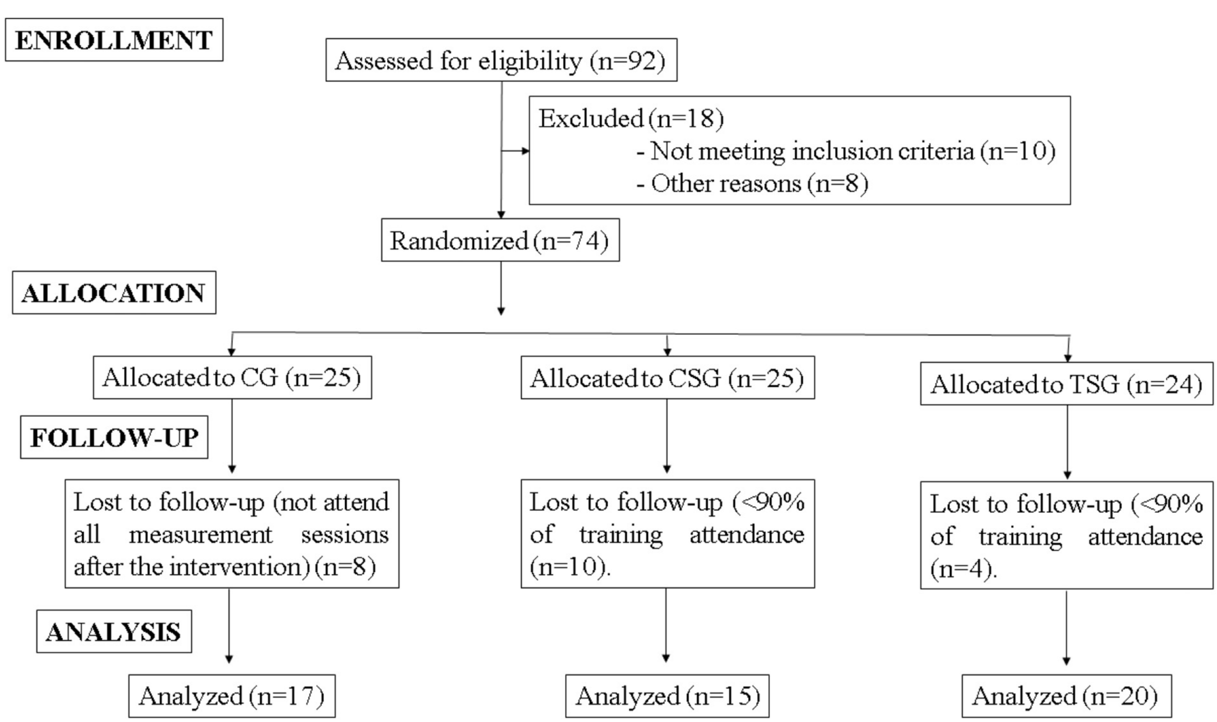

Fig. 1. CONSORT diagram of recruitment and randomization process.
Abbreviations: CG: control group; CSG: cluster-set group; TSG: traditional-set group.