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Effects of feedback-based balance and core resistance training vs. Pilates training on balance and muscle function in older women: A randomized-controlled trial

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ABSTRACT

Background: Aging is associated with decline in physical function that could result in the development of physical impairment and disability. Hence, interventions that simultaneously challenge balance ability, trunk (core) and extremity strength of older adults could be particularly effective in preserving and enhancing these physical functions.
Objective: The purpose of this study was to compare the effects of feedback-based balance and core resistance training utilizing the a special computer-controlled device (Huber®) with the conventional Pilates training on balance ability, neuromuscular function and body composition of healthy older women.
Methods: Thirty-four older women (age: 70 ± 4 years) were randomly assigned to a Huber group ($n = 17$) or Pilates group ($n = 17$). Both groups trained for 8 weeks, 3 times a week. Maximal isometric strength of the trunk flexors, extensors, and lateral flexors, leg power, upper-body strength, single- and dual-task static balance, and body composition were measured before and after the intervention programs.
Results: Significant group × time interactions and main effects of time ($p < 0.05$) were found for body composition, balance ability in standard and dual-task conditions, all trunk muscle strength variables, and leg power in favor of the Huber group. The observed improvements in balance ability under both standard and dual-task conditions in the Huber group were mainly the result of enhanced postural control in medial-lateral direction ($p < 0.05$).
Conclusion: Feedback-based balance and core resistance training proved to be more effective in improving single- and dual-task balance ability, trunk muscle strength, leg power, and body composition of healthy older women than the traditional Pilates training.

1. Introduction

Aging is associated with decline in physical function that could result in the development of physical impairment and disability both of which increase the risk of falls and fall-related injury. With respect to risk of falling and functional performance, aging-related deteriorations in postural control (balance) and muscle strength and power are of particular importance (for review, see Refs. (Granacher, Zahner, & Gollhofer, 2008; Granacher, Gollhofer, Hortobágyi, Kressig, & Muehlbauer; Pijnappels, van der Burg, Reeves, & van Dieën, 2008)). Given that falls represent the leading cause of injury deaths for adults over age 65 and the most common cause of nonfatal injuries and hospital admissions for traumatic injuries (Sleet, Moffett, & Stevens, 2008), interventions aimed at preserving and enhancing the above mentioned neuromuscular functions in older adults are of particular scientific and clinical interest.

So far, a number of exercise modalities have been recognized and evaluated regarding their effectiveness in fall prevention and preservation of functional performance (for review, see Refs. (Gillespie et al., 2012; Granacher, Muehlbauer, Zahner, Gollhofer, &

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Kressig, 2011)). Among them, most often studied have been balance training and resistance training, respectively. Recent literature reviews and meta-analyses support the use of balance perturbation training in functional performance enhancement and fall prevention in older individuals (Sherrington, Tiedemann, Fairhall, Close, & Lord, 2011; Shubert, 2011). However, evidence that support the efficacy of lower extremity resistance training in balance or functional performance improvement is less compelling (Carter, Kannus, & Khan, 2001; Orr, Raymond, & Fiatarone, 2008). Notably, most resistance training studies in older adults included lower extremity exercises, which apparently do not transfer effectively strength gains to improvements in balance, functional tasks, or rate/risk of falling (Orr et al., 2008). On the other hand, training modalities focused on increasing core function (*e.g.* Pilates training) proved to be effective in improving balance, functional performance, and in reducing the risk of falling in healthy older adults (Granacher et al., 2013; Barker, Bird, & Talevski, 2015). By definition, the anatomical core represents axial skeleton and all soft tissues with a proximal attachment originating on the axial skeleton, regardless of whether the soft tissue terminates on the axial or appendicular skeleton (upper and lower extremities; (Behm, Drinkwater, Willardson, & Cowley, 2010)). In theory, a strong and functionally stable core may contribute to more efficient use of the extremities and improved balance/functional performance in older individuals (Granacher et al., 2013). Thus, balance perturbation training and core training appear to be effective exercise modalities for improving physical function (balance, core strength, and functional performance in particular) in older adults.

Recently, a combined balance and core resistance training device named Huber® (LPG Systems, Valence, France) has been introduced and promoted (Couillandre, Duque Ribeiro, Thoumie, & Portero, 2008; Fabre, Martin, Borelli, Fritsch, & Theurel, 2014; Guiraud et al., 2015). The Huber device consists of an oval motorized platform, which performs rotating, oscillatory movements of controlled amplitude and speed, and two large handles with force sensors, mounted on a movable column (see also Section 2). The platform interferes with the balance of the subject who must continually adjust his/her posture by exerting isometric pushing and pulling efforts with the arms (Couillandre et al., 2008). As a result, the device provides postural and muscle adaptation with visual force feedback. This type of training lasting only 20–30 min per session proved to be effective in improving static balance, leg and trunk extensors strength (Couillandre et al., 2008), as well as in improving body composition and reducing the energy cost of walking in young adults (Fabre et al., 2014). Also, recent clinical study demonstrated that Huber training can safely and

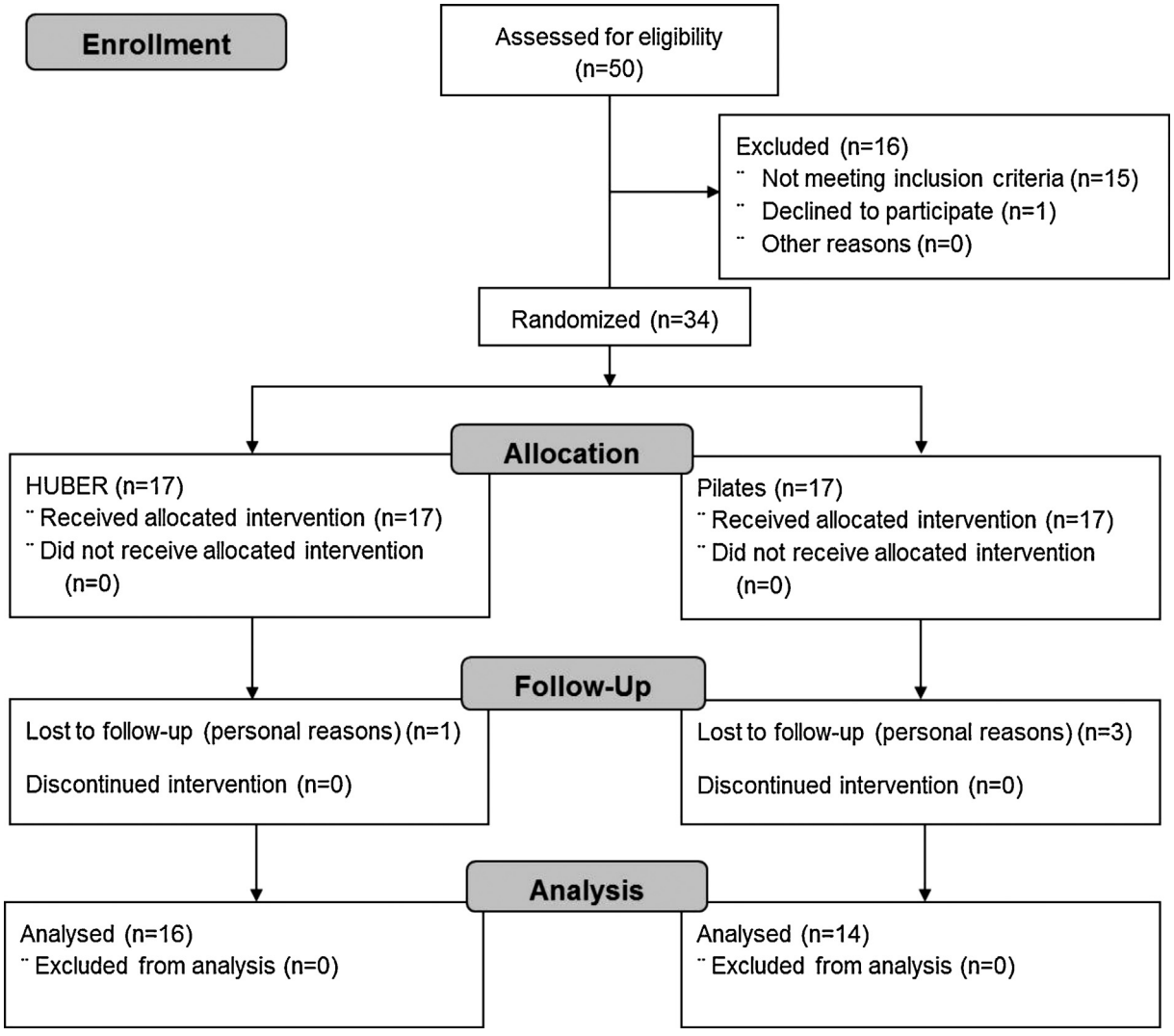

Fig. 1. Flow diagram of the progress through the phases of a parallel randomized trial.

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