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ORIGINAL RESEARCH

Effects of strength and balance training on the mobility, fear of falling and grip strength of elderly female fallers

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Summary The aim of this study was to evaluate the effects of virtual reality and strength training on the balance, fear of falling and handgrip strength of older women with a history of falls. The fear of falling, mobility and grip strength were evaluated in 11 elderly fallers (72.4 ± 5.2 years). The faller group was submitted to 12 weeks of virtual reality and muscle strength training. The results showed improvement in mobility ($p = 0.0004$) and in the fear of falling ($p = 0.002$). No significant difference was observed for hand grip strength. It can be concluded that virtual reality and muscle strength interventions are beneficial for mobility and fear of falling in older women with a history of falls.

Introduction

Falls are a major public health problem among older adults. In addition to being the second cause of death due to accidental injury in the world (OMS, 2012), falls are also responsible for fractures, hospitalization, functional dependency, decreased quality of life, and fear of falling (Masud and Morris, 2001; Perracini and Ramos, 2002), as well as direct and indirect costs. A treatment program consisting of muscle strengthening and balance training is the most promising intervention for reducing the number of falls (Granacher et al., 2011; Gschwind et al., 2010) and the fear of falling (Karinkanta et al., 2012).

Postural balance training involving new technologies can promote more challenging situations for the elderly, increasing patient motivation and adherence to the program (Brütsch et al., 2010; Gil-Gómez et al., 2011; Penko

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and Barkley, 2010). Virtual reality is the interaction with graphic images in which an interface exists between the individual and the machine, relating the computational components to sensorimotor channels (Schiavinato et al., 2010). The system provides immediate visual feedback, allowing users to make changes in motion according to the situations of the games and thus to develop strategies to restore and/or maintain postural balance (Clark et al., 2010; Schiavinato et al., 2010), and may therefore be effective for the prevention of falls. Few studies have evaluated the effects of virtual reality exercise on the fear of falling and mobility of older adults.

Therefore, the aim of the present study was to evaluate the effects of virtual reality and strength training on the mobility, fear of falling and grip strength of older women with a history of falls.

Methods

Sample

The study population consisted of 11 noninstitutionalized female volunteers aged 60 years or older (mean 72.4 ± 5.2 years) recruited at primary health units, health centers, community centers for the elderly, and geriatric clinics from the city of Marilia, São Paulo, Brazil. The subjects did not perform guided exercise and were able to walk independently. The sample size was estimated by *G*Power Software* considering a significance level of 5%, power of test of 80%, and an effect of size of 0.70. Fallers were classified according to a history of falls in the last 12 months (Gonçalves et al., 2009; Bekibele and Gureje, 2010; Sai et al., 2010). The design of the study is illustrated in Fig. 1.

The participants did not have neurological or musculoskeletal disorders or pain that interfered with their daily activities, lower extremity joint replacement, or orthostatic hypotension. The participants had normal scores on the Mini-Mental State Examination (mean 23.7 ± 4.3) (Brucki et al., 2003). At the time of testing, the women reported no use of psychoactive or vasoactive medications.

Written informed consent was obtained from all participants before enrollment. The study was approved by the Research Ethics Committee of the Faculty of Philosophy and Sciences, Universidade Estadual Paulista (Unesp), Marília, São Paulo, Brazil, and was conducted in accordance with Resolution No. 196/96 of the National Health Council.

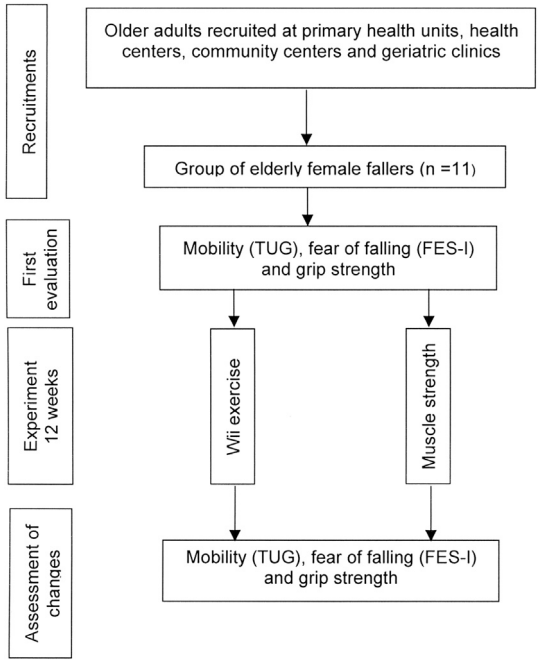

Figure 1 Data collection procedures.

Data collection

The participants answered a questionnaire regarding age, educational level, history of falls, dominant limb, presence of diseases, and use of medications.

Fear of falling was assessed using the Falls Efficacy Scale-International (FES-I) which evaluates the level of concern about the possibility of falling when performing 16 activities. The level of concern is measured on a scale from one to four. The total score ranges from 16 (no concern) to 64 (extreme concern) (Camargos et al., 2010).

A Timed Up and Go (TUG) test was used to evaluate mobility. This test determines the time (in seconds) required for the subject to rise from a standard armchair, walk 3 m away, turn, return to the chair, and sit down again (Podsiadlo and Richardson, 1991). A test time less than 10 s indicates normal balance and mobility of older adults (Lopes et al., 2009).

Muscle strength was assessed by measuring grip strength with a hydraulic dynamometer (BASELINE®), adjusted in the second position (Caporrino et al., 1998). Three measurements were performed at an interval of one minute, alternating between the dominant and non-dominant side, and the highest value was considered for analysis. The volunteers were instructed to perform the strength test during expiration, without the Valsalva maneuver, and were verbally encouraged.

Training program

The group of elderly fallers was submitted to 12 weeks of a muscle strength and balance training program, twice a week on alternate days, with each session lasting approximately 60 min (30 min of strength training and 30 min of balance training). The participants were instructed not to perform any other type of exercise during the training period.

Strength training

The participants were familiarized with the exercise for 2 weeks prior to training by performing a series of strengthening exercises of the quadriceps, gastrocnemius and tibialis anterior muscles at a fixed minimum load of 0.5 kg (Brown and Weir, 2001). After this period, a 10 repetition maximum (10 RM) test was performed for each exercise modality to determine the load that each patient would begin training. The 10 RM test was performed after global