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Comparison of the effects of water- and land-based exercises on the physical function and quality of life in community-dwelling elderly people with history of falling: A single-blind, randomized controlled trial

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ABSTRACT

Purpose: The purpose of this study was to identify the effects of water-based exercises on the physical functions and quality of life (QOL) in community-dwelling elderly people with history of falling.
Materials and methods: Participants were randomly assigned to the water-based exercise group ($n = 34$) or land-based exercise groups ($n = 32$). To identify the effects on physical functions, muscle strength, flexibility, and mobility were measured. QOL and fear of falling were evaluated using the Short Form 36-item questionnaire and the modified falls efficacy scale (M-FES). The measurements were performed before and after the 10-week training period.
Results: Within-group analysis indicated that hip abduction and adduction strength improved significantly in both groups ($p = 0.005$; $p = 0.007$). However, no statistically significant within-group differences were found in the back scratch test ($p = 0.766$) and chair sit-and-reach test ($p = 0.870$). QOL was significantly different in both groups (health transition: $p = 0.014$, physical functioning: $p < 0.001$, role physical: $p < 0.001$, role emotional: $p = 0.002$, bodily pain: $p < 0.001$, vitality: $p < 0.001$, and mental health: $p < 0.001$). There was a significant difference in the M-FES in both groups ($p = 0.040$).
Conclusions: These results indicate that water-based exercises are beneficial to improve the QOL, as well as physical activities, of community-dwelling elderly compared with land-based exercise. Water-based exercises would be useful to improve physical and psychological health in the elderly people with history of falling.

1. Introduction

Fear of falling can hinder activities of daily living and mobility among the elderly, which can translate into a reduced quality of life (Arfken, Lach, Birge, & Miller, 1994; Kim & So, 2013). Approximately 50% of falls occur to elderly people that reside alone in communities, and half of them experience twice or more falls (Masud & Morris, 2001). Once healthy elderly people experience falls, they tend to require long-term hospice care because of body fractures and psychological stress (Hardy & Thompson, 1998; Kirsebom, Hedström, Wadensten, & Pöder, 2014). Moreover, the number of elderly people experiencing falls is increasing globally; thus, associated medical costs are expected to increase geometrically in the future (Roudsari, Ebel, Corso, Molinari, & Koepsell, 2005; Stevens, Corso, Finkelestein, & Miller, 2006).

The primary cause of falls among elderly people is the decline in physical functions secondary to aging (Reinsch, MacRae, Lachenbruch, & Tobis, 1992; Tinetti, Speechley, & Ginter, 1988). Recent randomized controlled trials attempted to evaluate traditional land-based exercises focused on preventing falls among elderly people (Chang et al., 2004; Close et al., 1999). It was reported that land-based exercises improve the lower limb strength of elderly people, as well as other physical functions. Additionally, such exercises seemed to prevent falls among elderly people

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(Clemson et al., 2004; Macaluso & De Vito, 2004). Land-based exercises increase physical activity, which translates into an improved quality of life (Fraga, Cader, Feereira, Giani, & Dantas, 2011; Takata et al., 2010).

Unlike land-based exercises, water-based exercises help to minimize the effect of gravity on the body, which reduces the burden on joints, and the high density of water can reduce the risk of falling (Camilotti, Rodacki, Israel, & Fowler, 2009). During water-based exercise, body balance is affected by both gravity and buoyancy. However, if one is stronger or these factors are not collinear, a metacentric effect with two powers is the result (Becker, 2009). This metacentric effect induces body perturbation and proprioception stimulation that enables an active reduction of body instability.

In previous studies, however, there were no statistically significant differences between water-based exercise groups. Additionally, there were no statistically significant differences between control groups of elderly people, and balance, function, and quality-of-life groups (Cochrane, Davey, Matthes, & Edwards, 2005). Moreover, water-based exercise training on elderly people resulted in significantly improved balance and flexibility, but no significant differences were reported regarding strength (Hale, Waters, & Herbison, 2012). In a 10-week intervention study for more than 65 years, the water-based exercise group showed increased balance compared to the land-based exercise group (Devereux, Robertson, & Briffa, 2005).

The purpose of the present investigation was to study differences between the water- and land-based exercise groups after 10 weeks of exercise for elderly people with history of falling. We hypothesized that the water-based exercise group should improve more in terms of fall efficacy, physical functions, and quality of life compared with the land-based exercise group after 10 weeks' intervention for elderly people with history of falling. To test our hypothesis, we conducted the exercises in water- and land-based groups of elderly people with history of falling for 10 weeks.

2. Subjects and methods

2.1. Design

This study was a single-blind study, and participants were assigned randomly to water- or land-based exercises. Randomization was designed according to the CONSORT guidelines, using the blocked randomization (Moher et al., 2012). All examiners were blinded to group allocation. This study was conducted for 10 weeks, and participants were evaluated prior and after the intervention. The study was approved by the Ethical Committee of the University of Korea. Afterward, all the participants signed informed consent forms.

2.2. Participants

Participants consisted of elderly people recruited from two community welfare centers. In total, 105 elderly participants were prescreened, and 80 were selected (Fig. 1). The participants were randomly assigned to each group of 40 elderly people. Inclusion criteria were as follows: (a) subjects aged 65 years or older, (b) those that experienced more than one fall within the previous 3 months, (c) those who did not exercise regularly, and (d) those who provided written informed consent. Exclusion criteria were as follows: (a) subjects with any cardiovascular or psychological disease, (b) those who underwent surgery or experienced trauma within the previous 3 months, and (c) those who presented fear or difficulty to perform excises in water.

2.3. Intervention

The water-based exercise program was based on aqua correct fit combined with smooth ballet movements (Table 1). It was applied three times per week during 10 weeks to participants in groups in an indoor swimming pool, which is 1.2 m deep, with an average temperature of 28 °C and average outdoor temperature of 27–30 °C.

We conducted a land-based exercise program inside of a community welfare center and carried out general exercises combined with smooth movements. Indoor temperature was maintained at 25 °C. One instructor and 2 assistant instructors led the exercise. The exercise intensity in both groups was set using the rating of perceived exertion. Exercises for both groups involved the same muscular groups, and the rating of perceived exertion was maintained at 4 of a 10-point scale (i.e., somewhat heavy exertion).

All the instructors had more than 3 years of clinical experience in physical therapy. Each exercise was conducted by one instructor and two assistant instructors. The total exercise time was

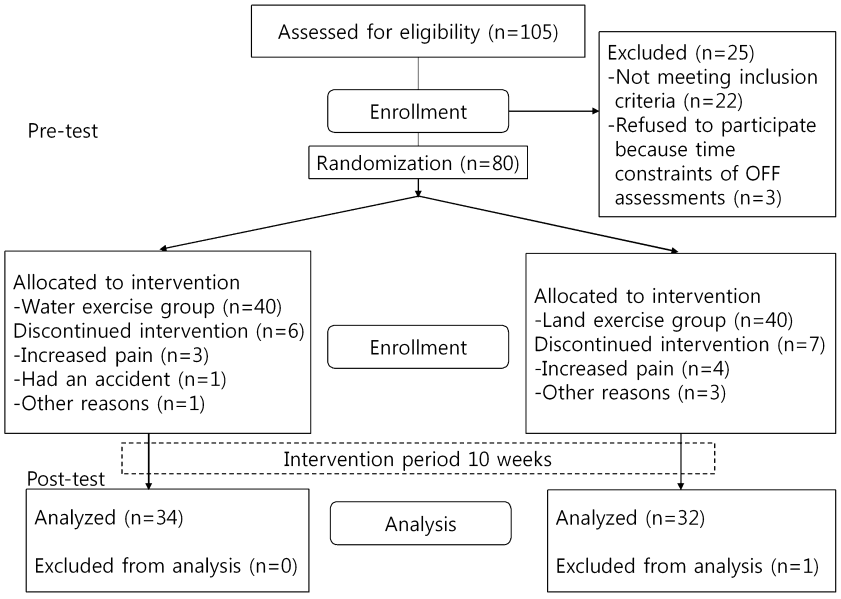

Fig. 1. Flow diagram of participant enrollment.