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The effects of water and land exercise programs in static and dynamic balance among elderly men

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Abstract

Aim: Lower body exercises are an important intervention in retraining balance. The aquatic environment has been identified as an appropriate medium to perform these exercises. The purpose of this research was to compare Static and Dynamic Balance following water and land exercise in elderly men.Methods: Thirty elderly men completed this study. 15 subjects were from an assisted living facility (age 63.2 ± 4.2years) and 15 subjects were from an outpatient facility (age 65.6 ± 3.9 years). Each group did a comparable set of lower body exercises (3 times per week for 6 weeks), but one group exercised in the pool, and the other exercised on land. Pre- and post-intervention tests of static and dynamic balance were conducted. Measures included the Sharpened Romberg and eight-feet time up and go Test. Results: At pre-test there was no significant difference between the two groups' Static and Dynamic Balance ($p>0.05$); the water exercise group showing better performance than the land exercise group ($p<0.05$). There was also significant differences between pre- and post-test results of the water exercise group on all the tests ($p<0.05$). The land exercise group showed significant differences from pre- to post-tests on static balance with open and closed eye and Dynamic Balance ($p<0.05$).Conclusion: Although the results support the positive effects of water and land exercise static and Dynamic Balance for male elders, water

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exercise proved to be more beneficial than land exercise in improving the elders' physical capability to maintain their body balance.

Keywords: Older adult men, water exercise, land exercise, static and dynamic balance

1. Introduction

Falls are the leading cause of fatal and nonfatal injuries among the elderly; they represent a major health and socioeconomic problem that costs the people of the United States an estimated $7-10 billion per year (Gregg et al 2000; Boudoin et al 1996; Wolinsky et al 1997). After the age of 65, %10 of the older adults lose their independence to do one or more daily tasks (Beissner & Collins 2000). Between the ages 65-75, one out of nine, between the ages 75-85, one out of four and, from 85 upward, three out of five people faces difficulty doing basic life tasks (Beissner & Collins 2000; Harada et al 1995). As a result of aging, muscles lose their strengths along with other parts of the body; reduced muscle strength is an important factor of disability and a main reason for one's ability for balance and walking properly (Guccione 1993). Eight percent reduction of strength in the third decade of life begins in arms and feet muscles; in the 7th and 8th decades of life, reduction of isometric strength of different muscles of the body amounts to 20 to 40 percent (Guccione 1993). Age-related declines in muscle mass or sensorimotor systems may contribute to decreased balance and stability while walking. MacRae and colleagues identified muscular weakness in the hip abductor, knee extensor, knee flexor, and ankle dorsiflexor muscles as being related to an elder’s risk for falls (MacRae & colleagues 1992). The literature indicates that exercises that are repetitive, of high intensity, and continuous are desirable to achieve increased strength in community dwelling elders (Judge 1994).

Balance, strength, and proprioception may be addressed in an aquatic environment(Hurley & Turner 1991) According to Campbell et al, activities in water are appropriate for the geriatric popula population (Campbell et al 1989). Ruoti and associates described the support offered by water as allowing more independent upright postures (Ruoti et al 1997). They posited that in water there may be an increase in afferent stimulation from greater cutaneous inputs, that muscles may be more freely firing, as patients are less fearful of movement, and that activity in water may facilitate vestibular inputs (Ruoti et al 1997). Exercising in water may be more appropriate than on land for those with musculoskeletal impairments. Joint loading diminishes relative to the depth of immersion (Ruoti et al 1997). Thein and Brody-Thein found that being submerged to the level of the anterior superior iliac spine allows for a 54% reduction in weight bearing, thus reducing lower extremity stress (Thein & Brody-Thein 1998). Consequently, aquatics may be a more effective balance intervention for those elders with significant joint pathology. The warm water of the pool has the potential to increase the circulation to the involved joints, relax muscles, and temporarily decrease pain Exercise in water can slow the speed of falling, secondary to the properties of viscosity and density, allowing an individual with impaired balance more time to detect postural errors that might lead to a fall (Suomi & Koceja 2000; Simmons & Hansen 1996).

This study investigated the utilization of similar balance retraining exercises in the water and land-based environment. The primary purpose of this study was to compare static and dynamic balance in older adult men following training in water and land environments.

2. Method

2.1. Participants

This research employed a semi-experimental design with pre- and post-tests. Thirty older adult men between 63-70 years old were selected. All the participants were from Mashhad. They were independent of others in doing their daily activities, and were capable of doing the study exercises (as confirmed by a physician).The criteria for exclusion from the study were neurological defects (e.g., apoplexy, Parkinson's), cardio-vascular defects, chronic impermanent disease (e.g., diabetes), severe congenital defect and limiting skeleton-muscle problems. Moreover, the participants maintained that they had no special physical training or regular walking program (e.g., at least two times per week for 30 minutes); this means that they had low mobility during the last 5 years (Candeloro & Caromano 2008)

The participants volunteered to the study and were randomly divided into two equal groups of (a) water exercise (N =15) with mean age of 63.2 ± 4.2 years, height 172.33± 4.67 cm., and weight 71.13± 3.7 kg; and (b) land exercise (N=15) with mean age of 65.6 ± 3.9 years, high 173.20± 4.84 cm, and weight 72.86± 3.4 kg.

2.2. Measurements

Measurements of the participants' static and dynamic balance were carried out before and after the exercise program.

Assessment of static balance of participants was carried out as follows using the Sharpened Romberg Test. The participant was asked to stand straight with naked feet, putting one foot in front of the other and his or her arms crossed upon the chest; the score given to each individual was the time he could maintain a stable state with open and then with closed eyes(Paula & Yim-Chiplis Laura, 2000). Because the participants were unaware of the scoring, they were asked to repeat the task three times (in order to control for the plateau effect) before the main test; next, in a separate trial, they performed the task for another three times, for which an average score was calculated and considered as an index for their ability to maintain balance.

The Time Up & Go test provides rapid monitoring to detect balance problems elderly men. The shorter the time used to complete the test, the better the balance is. The time it took for the elderly men to get up from a chair, walk a distance of eight-feet, turn around, walk back to the chair and sit down again was measured in seconds (Podsiadlo & Richardson 1991). The elderly ¬men did the test once to become familiarized with it and, on the second attempt; the time was recorded (Podsiadlo & Richardson 1991).

2.3. Exercise Protocol

Exercises were comparable for both land and water and were administered 3 times a week for 6 weeks. Subjects exercised to their tolerance and were allowed rest periods as needed. Subjects were strutted to report any discomfort immediately. Land exercises were conducted indoors in an assisted living recreation area. Water exercises were performed in an indoor pool with a temperature that was 33° Celsius (92° F). The aquatics group used the Aqua motion, In ground Custom Therapy Pool (Longmont Colo) The dimensions are 11’ x 17’8” and 3’, 4’, and 5’ depths. Each depth has a lane within the pool of 3 feet. This allowed accommodation for the variable height of the subjects (Douris et al 2003).

Walking activities: Done 3 times each 1- Walking forward 11 feet. 2- Marching forward 11 feet. 3- Sidestepping without crossing legs 11 feet. 4- Tandem walking 11 feet.

Exercise activities: One set of 15 repetitions 1- Marching in place. 2- Hip flexion/extension. 3- Hip abduction/adduction. 4- Toe raises/heel raises. 5- Shallow knee bends. 6a- Sit to stand from chair in land group. 6b- Sit to stand from pool shelf in aquatic group.

The subjects exercised in a water level based on their height; the water level was between their waist and nipple line. Subjects in the aquatic group worked in the pool as 1 group of 15 in order to reduce any possible difficulty that would arise from increased turbulence of the water. As a result, all subjects completed the exercise activities while the other 3 simultaneously worked on the walking portion of the protocol. The pool had a shelf adjacent to its entrance, approximately 12 inches (seat depth) and 24 inches (seat height). The shelf ran the length of the pool and served as the sit to stand site. There was a spotter available in the pool while the subjects were exercising. In addition to an available spotter, the land exercisers could hold on to a stationary chair or their assistive device for stabilization if necessary.

3. Results

Among the 30 elderly men initially selected, they completed the study and were reevaluated after 8 weeks. Two participants in the water exercise (WE) group and land exercise (LE) group had to discontinue their program due to health problems.

The participants' mean age was 63.2 years (SD=4.2; range 63–70) in the WE group, 65.6 years (SD=3.9; range 63–70) in the LG group. There was no significant age difference among the groups (p=0.633).

Figure 1 represents the test measurements: a) Static balance with open eyes (SBOE); b) Static balance with close eyes(SBCE); c) Dynamic balance(DB) before and after the intervention. No variables showed differences between the groups before the intervention, thus indicating that the sample was homogeneous (Table 1). After the intervention, the SBOE, SBCE and DB variables showed significant differences between the intervention water and land exercise groups (SBOE)f: 0.104; p= 0.001), SBCE(f: 0.501; p=0.002), DB(F: 0.181; P=0.001)(Table 1).

Table1. The differences between the intervention water and land exercise groups in SBOE, SBCE and DB

test		Water exercise	land exercise	Independent t-test	f	df	*P* value
Static balance with open eyes	Pre-test	33.04±1.81	33.34±2.13	-0.414	0.545	28	0.682
	Post-test	40.57±2.98	36.63±2.55	3.883	0.104	28	0.001
Static balance with close eyes	Pre-test	10.72±1.29	10.95±1.23	-0.502	0.052	28	0.620
	Post-test	14.09±1.86	12.12±1.12	3.516	0.501	28	0.002
Dynamic balance	Pre-test	10.21±0.96	10.37±0.58	-0.564	2.028	28	0.577
	Post-test	7.74±1.01	9.15±1.15	-3.557	0.181	28	0.001

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Table 2. Within-group comparison of the participants' SBOE, SBCE and DB

Group	Test	Pre-test (M ± SD)	Post-test (M ± SD)	Paired sample t-test	df	P value
Water exercise	Static balance with open eyes	33.04±1.81	40.57±2.98	-10.245	14	.000
	Static balance with close eyes	10.72±1.29	14.09±1.86	-6.615	14	.000
	Dynamic balance	10.21±0.96	7.74±1.01	12.152	14	.000
land exercise	Static balance with open eyes	33.34±2.13	36.63±2.55	-4.954	14	.000
	Static balance with close eyes	10.95±1.23	12.12±1.12	-3.715	14	0.002
	Dynamic balance	10.37±0.58	9.15±1.15	3.855	14	.002

4. Discussion

This study was designed to compare the effectiveness of similar balance retraining interventions performed in a land versus Water environment. The results of this study demonstrated that regardless of the exercise medium, significant improvements in balance were achieved by lower body exercise. These findings conflict with the conclusions of Simmons and Hansen(Judge, 1994).They concluded that postural control improved greatest in the Water group as compared to a land group (although both groups showed improvement), when measured using Sharpened Romberg Test and Time Up & Go test. The older adults can benefit from physical activities aiming at increasing or maintaining muscle strength and balance. Our findings on the effect of exercise on balance also support those of Costill (1997), Resende et al. (2007) and Simmons and Hansen (1996). these authors also compared training in water and land exercise and merely used functional tests or berg balance index to evaluate the effects of different training periods.

Therefore, Simmons and Hansen (1996) would have realized a ceiling effect, if the balance was used to score forward reach. Our direct comparison used a balance specific comprehensive approach toward assessment of balance retraining effects of 2 interventions over 6 weeks' time. The balance in this study as a multiple measure of Sharpened Romberg Test and Time Up & Go test. The main finding from this study was that static and dynamic balance in elderly men could be improved through the use of land-based or aquatic- based therapeutic exercise. We found land- and aquatic based exercise conducted over a 6-week period was effective in promoting balance improvement. This study adds to the evidence base of effective interventions for balance retraining in the community-based elderly. In today's health care climate there is increased accountability of the rehabilitation personnel with regard to evidence-based practice, to achieve reimbursement. Lower body activity as described in either medium is effective in increasing balance outcomes as determined using the Sharpened Romberg Test and Time up & Go test. Evidence indicates the positive effects of water exercise for those who are at risk of falling or are afraid of falling(Simmons & Hansen 1996; Booth 2004; Devereux et al., 2005; Douris et al., 2003). Surface twitch of water makes movement in water slow and prevents falling–if a person loses his or her balance in water, he or she has more time to recover balance. Thus water exercise not only increases self confidence in older adults, but also it reduces falling fear. Therefore, older adults who do water exercise can continue to improve balance and stability without any fear of falling (Geigle et al 1997; Salzman 1998). Although exercising in water may be more appropriate than land exercises for individuals with musculoskeletal problems we found in these 2 groups that land and water were both beneficial. Considerations of availability, cost, and maintenance of the therapeutic pool will guide the clinician in the decision making process for balance retraining in the well elderly. All subjects within the study were genuinely interested and enthusiastic in the balance training and were fully compliant to the program. Consistent participant attendance was achieved and thus played a vital role in outcomes measured. One substantial limitation of the study was the sample size. Increasing the sample size would have increased the statistical power of our study. The lack of random assignment due to recruitment issues also may have affected our results due to the inherent differences between the groups. It is impossible to know that these results would be achieved for all community dwelling elders. Researchers of future studies might wish to extend this to larger groups. Other variables that warrant attention are the duration, intensity, and frequency of the intervention. Most of the literature reviewed used different frequencies and durations for the intervention program. Future aquatic/land-based balance studies might use a combination of 2 or more balance assessment tools such as the Sharpened Romberg Test and Time Up & Go test, and a gait performance tool to substantiate any improvements in functional balance ability. A higher level gait examination such as the Dynamic Gait Index might be considered for this independent and mobile population (Riddle & Stratford, 1999). Reassessments of participants at different intervals to determine the duration of the gains made during retraining, or when the significant gains were achieved, would be beneficial

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