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Balance Specific Training in Water and on Land in Older Adults: A Pilot Study

Robyn Lin Anderson and Elizabeth Fishback

This study compared the effectiveness of water and land based balance specific exercise in older adults. Twelve participants engaged in either water (W) or land (L) exercise consisting of a standard class and balance training. Both classes exercised for 60 min, 3 times a week for 8 weeks. Balance tests were administered pre and postintervention. A 2 × 2 factorial ANOVA with repeated measures on the second factor ($p < .05$) demonstrated that participants of both groups improved significantly in functional reach, timed "up & go," step test right and left leg, and 6-min walk. No changes were found in tandem gait or one-leg stance and the interaction between the exercise conditions. These results suggest that when both water and land-based programs focus on balance-specific training, the mode of exercise is less important than the specificity of the intervention. I conclude that water exercise is an important mode to consider for improving balance in older adults due to the supporting nature and the safe exercise environment of the water.

The incidence and severity of falls in the elderly is alarming. For example, over one in three older adults fall each year (Kenny, Rubenstein, Martin, & Tinetti, 2001; Sato, Kaneda, Wakabayashi, & Nomura, 2007) with age being an important risk factor, as fall risk doubles for those over the age of 80 years (Rubenstein, 2006). Falls are a major clinical concern in older adults as they precipitate reduced functioning, post fall syndrome, premature nursing home admission, and mortality (Clark, Lord, & Webster, 1993; Rubenstein, 2006). In the United States, the 5th leading cause of death is unintentional accidents, and falls account for two-thirds of the deaths in this category (Carter, Kannus, & Khan, 2001; Ramsbottom et al., 2004). In addition to aging, many other biological changes exist that increase the risk of falls, including clinical diseases and losses in vestibular and visual system function. Studies have shown that balance and gait type changes and abnormalities are important predictive factors for falls in the elderly (Bergland, Sylliaas, Jarnlo, & Wyller, 2008; Cromwell & Newton, 2004; Kronhed & Möller, 1998). Once an older adult falls, a detrimental spiral of inactivity occurs due to muscle detraining and weakness, further increasing the risk of subsequent falls.

Regular exercise is effective in maintaining and improving some of these aforementioned biologic changes that are associated with age and potential fall risk. There are several issues to consider regarding exercise that remain unclear; such issues include the optimal mode(s) and type(s) of exercise programs recom-

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mended to reduce falls in older individuals (Carter, Kannus, & Khan, 2001). For example, surveys indicate that between 30% and 73% of older individuals who have fallen are afraid they will fall again (as reported in Rubenstein & Josephson, 2006). Because many older adults have a "fear of falling," the mode of exercise is important. For this reason, perhaps water-based exercise programs should be an option for these individuals compared with conventional land-based programs, because water eliminates the consequences of falling during exercise (Rubenstein & Josephson, 2006). Moreover, exercise in the water provides a means for those with chronic arthritis or other orthopedic conditions to participate (McIlveen & Robertson, 1998; Jentoft, Kvalvik, & Mengshoel, 2001).

Another issue to consider is the optimal type of exercise needed to address falling risk. In an effort to recommend guidelines for fall prevention in older adults, the American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopedic Surgeons Panel on Falls Prevention found that balance training is one of the most important factors in an intervention program for preventing falls. The Panel's recommendations, based on a thorough literature review, indicated that the evidence for fall prevention was strongest for programs that emphasized balance training, while there was less evidence for programs that focused on resistance and aerobic training. In addition, the most effective programs were those that exceeded 10 weeks duration and were sustained for long term benefit (Kenny et al., 2001).

Many water-based exercise studies have demonstrated improvements between programs of similar intensities in cardiovascular fitness, body composition, muscle strength, and flexibility (Campbell, D'Acquisto, D'Acquisto, & Cline, 2003; Gappmaier, Lake, Nelson, & Fisher, 2006; Ruoti, Troup, & Berger, 1994; Sato, Kaneda, Wakabayashi, & Nomura, 2007; Shono, Fujishima, Hotta, Ogaki, & Ueda, 2001; Takeshima et al., 2002; Tsourlou, Benik, Dipla, Zafeiridis, & Kellis, 2006; Wang, Belza, Thompson, Whitney, & Bennett, 2007). And while some aquatic exercise studies have shown improvements in balance measures, including functional reach (Simmons & Hansen, 1996), postural sway (Lord, Mitchell, & Williams, 1993; Suomi & Koceja, 2000), and step test (Devereux, Robertson, & Briffa, 2005), these studies did not have the specific aim to overload or challenge the targeted balance systems (i.e., sensory, central integrative, and motor). As noted by Sherrington, Whitney, Lord, Herbert, Cumming, and Close (2008) following a comprehensive review and meta-analysis of best exercise interventions for fall prevention, the most effective programs were those that directly "challenged" the multifaceted components of balance.

Most recently Melzer, Elbar, Tsedek, and Oddsson (2008) developed a comprehensive water-based exercise program grounded on the "principle of balance specificity" with exercises that mimic everyday perturbations in balance. For example, these authors state that to train participants in balance as a "skill," the exercises used must provide challenges that directly overload the participants' postural control system and are specific to the functional tasks the participants need to successfully perform. Thus, the exercises performed in balance specific training target movement in forward, backward, and sideward directions focus on rapid stepping reactions with intentional perturbations and frequently change the participant's base of support (narrow base or wide base) or use of other balance compensation mechanisms (e.g., use of arms, opening/closing the eyes, modality

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assistance). Moreover, the balance skills gradually progress in complexity according to the individual's level of success with the exercises.

Given that balance training is an important component of fall prevention, exploration of exercise programs aimed at specifically training each individual's balance as a skill is essential; such programs should be explored both in the water and on the land. Therefore, the primary purpose of this pilot study was to compare the effectiveness of water- and land-based balance "specific" training on functional balance in older adults.

Method

Participants

Twelve participants, between the age of 57 and 80 years, were recruited to participate in this study. The individuals in this convenience sample all had prior involvement in the Senior Fitness Programs at Alma College. The participants were divided into two groups, a water exercise group (W) with $n = 7$ and a land exercise group (L) with $n = 5$. Participants were assigned to their groups according to their prior exercise experience in water or on land. All participants had been exercising in their respective groups for a minimum of one month before the pretesting was begun. During this month-long exercise period, no specific balance skills were incorporated into the participants' exercise sessions; rather, the intent was to establish baseline equivalence for exercise participation between the groups due to the nonrandom water or land group assignment. Thereafter, participants in both groups underwent pretest balance assessments, exercised in their respective classes for 8 weeks with balance specific training, and then completed posttest assessments identical to the pretest. All of the participants signed an informed consent and the study was approved by the Institutional Review Board of Alma College. This study took place from January 2009 to April 2009.

Pre and Postexperimental Procedures

Before testing all participants completed a general health questionnaire, and six balance tests were then administered pre and postintervention. The administration of each test was identical in procedures between the W and L groups and included functional reach, tandem gait, timed "up & go," step test, one-leg stance, and the 6-min walk test. Participants wore comfortable clothes and athletic shoes for all the tests. The order of the tests administered differed for all individuals.

Functional Reach.
The functional reach test measures balance impairment and changes in balance performance while moving the upper extremity. A leveled yardstick was secured to the wall and placed at the height of the participant's acromion on the right arm. The participant stood perpendicular to the stick, feet shoulder width apart, and was instructed to make a fist and raise the arm parallel to the yardstick. The position of the end of the third metacarpal along the yardstick was recorded (position 1). The participant then reached as far forward as possible along the length of the yardstick (flexion at the waist was permitted), without taking a step or losing balance, and

the placement of the end of the third metacarpal distance was again recorded (position 2). Functional reach was defined as the difference between positions 1 and 2, measured in inches. Three trials were completed and the mean difference was calculated. Previous research has found functional reach to be a precise measure with good tester reliability (Duncan, Weiner, Chandler, & Studenski, 1990; Jette et al., 1999).

Tandem Gait. The tandem gait test measures dynamic walking balance ability over a narrow base of support. Participants stood on a line with their heel of one foot touching the toe of the other foot and their arms at their side. They were asked to walk heel-to-toe in succession and the number of successful steps was recorded. The test was stopped if the participant was unable to touch their heel-to-toe, if their arms came over 45° of abduction, or if they executed 10 steps. Three trials were completed with the average number of steps taken recorded for the data analysis. This balance measure has been shown to be both reliable and valid (Jette et al., 1999).

Timed "Up & Go". The "up and go" test measures both rising mobility and dynamic balance. Participants began seated in a chair 3 m from a line. Once the timer instructed the participant to "go," they rose from the chair (without using their hands), walked to the line, and returned to sit back down. The aim of this test was to complete it as fast as possible, as the total time is recorded on a stopwatch from when the participant was instructed to "go" and is stopped when they sat back down. This was repeated for a total of three trials and the average time was recorded. Studies have demonstrated this test to have both high interrater and intrarater objectivity and to correlate well to other balance tests such as the Berg Balance Scale (Podsiadlo & Richardson, 1991; Steffen, Hacker, & Mollinger, 2002).

Step Test. The step test measures a specific type of dynamic standing balance. This test stressed the musculature from both the lower limbs and the trunk. Participants stood at the base of a 7.5 cm high step and when instructed to do so they stood on one foot (all their weight was maintained on that leg for the entire test) and moved their opposite foot up onto the step and back down onto the floor as fast as they could for 15 s. Three trials were done for each foot, alternating between feet. The step test has high test-retest reliability (Hill et al., as cited in Devereux, Robertson, & Briffa, 2005).

One-Leg Stance. The one-leg stance test (also sometimes called a "stork stand") measures standing static balance. Subjects stood on one foot (the opposite leg flexed) on an even, hard surface for as long as they could for a maximum of 30 s. Compensatory movements of the arms and opposite leg were allowed. Three trials were completed for each leg, with the subject alternating the supporting foot; a 30-s rest was provided after each trial. Two conditions were tested—eyes open and closed. High reliability of this test has been demonstrated (as cited in Bergland, Sylliaas, Jarnlo, & Wyller, 2008).

The 6-Minute Walk Test. The six-minute walk test measures overall mobility and cardiorespiratory functioning (Lord & Menz, 2002; Lord et al., 2003). On a level course, the participants were instructed to walk as quickly as they could for six minutes without stopping. The tester followed behind the participant with the timer so not to set a pace and encouraged the participant with standard statements every

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2 min. The final distance of the walk completed was recorded in meters. Research has found this test to have good test-retest reliability, especially as a measure of exercise endurance in older people (Steffen, Hacker, & Mollinger, 2002).

Exercise Procedures

Land Exercise. All exercise classes placed an emphasis on balance-specific training in their programs. Attendance was recorded in both classes for the 8-week duration of the study. Participants in the L group met for 60 min, 3 times/week. Sessions included a 5-min warm-up, specific exercises that focused on balance, and a 5-min cool down. Equipment and exercises were changed frequently to vary the tasks that involved finding the participants' sense of balance in their environment. Some of these varied tasks consisted of changing arm positions, opening/closing the eyes, moving in a different direction, or modifying the base of support.

The 5-min warm-up consisted of interval training that incorporated marching in place, high knees, and jogging. For the balance segment of the sessions, there were a myriad of different exercises used that targeted static balance, dynamic balance, transferring weight, and multitasking. These were executed using a variety of equipment including aerobic steps (tapping, stepping, jumping, kicking), yoga balls (sitting balance, twisting, curling), ground exercises on a towel (superman holds, bicycle kicks, bridges), and standing/moving specific balance drills (barre work, one leg standing, tandem walking). In addition, light resistance exercises were completed using bands and free weights (2–3lbs). These included side steps, bicep curls, triceps, overhead lifts, kickbacks, flies (forward and sideways), shoulder rows, squats, and lunges. The cool down for these sessions concluded with a variety of static stretches for the upper and lower body.

Water Exercise. The W participants met for 60 min 2 times/week and chose an additional day to exercise in a standard water aerobics class in which balance-specific training was not the focus. This format was used due to the pool schedule for the water exercise sessions whereby an additional weekly class session for balance-specific training could not be added. W sessions were similar to the land exercises in that there was a 5-min warm-up, 50 min of specific balance exercises, and a 5-min cool down.

The W protocol modeled the training program described by Melzer and collaborators (2008) and focused on individualization, specificity, and progressive overload principles. The goal of these exercises was to create an environment where individuals would practice balance reactions in response to changes in speed, direction, and base of support. Moreover, gait exercises were completed in forward, backward, and sideward directions. Different combinations of movements were constantly implemented to create cognitive challenges. For instance, a hop could have been added to the end of a grapevine movement or a relevé onto the ball of the foot before a step. Once participants felt comfortable completing a certain task, they were challenged to increase the difficulty by placing their hands on their hips instead of sculling in the water, closing their eyes, or narrowing their base of support.

Similar to the land exercises, a variety of water equipment was used in the pool including hand buoys, aquatic noodles, and balance mini rollers. For example, the hand buoys were used for light resistance training of the arms and included movement through all planes of arm and shoulder motion (same arm exercises as

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on land). The aquatic noodles focused on balance exercises that included the participants standing, walking, or jumping on the noodle. Noodles were also used for a variety of other activities. For instance, it could be ridden like a horse or sat upon like the seat of a swing. A variety of different kicks were then completed in these positions: in place, moving forward/backward, or in a circle. Mini-rollers (12-inch long foam cylinder cut in half) were used specifically for balance or step training. Participants stood on the flat part so that the roller portion was pushed down to the bottom of the pool and practiced such tasks as standing, rocking, swinging the leg, or transferring weight with stepping actions.

During the first few weeks of the water exercise sessions, most of the participants began holding onto the pool wall when using both the noodles and mini-rollers and progressed to putting their hands on their hips. Once each of the movements was mastered participants were asked to move their arms in a big circle across their body at the same time they performed the lower body tasks to create perturbations. Again, the cool down for these sessions concluded with a variety of static stretches for the upper and lower body.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) General Linear Models procedure (version 11.0). Descriptive statistics (± *SEM*) and frequencies were determined for appropriate general characteristics. Comparisons of means for equivalence at baseline between the W and L groups were performed using independent t tests. Separate 2 × 2 (group × time) factorial ANOVAs with repeated measures on the second factor were run on each of the dependent variables. Significance for all tests was set at $p < .05$.

Results

All 12 participants underwent the pre and postexaminations and their data were used for statistical analysis. General characteristics and exercise attendance rates (81% for the W group and 72% for the L group) of the participants are presented in Table 1. Comparisons of the baseline data using independent t tests demonstrated a

Table 1 General Characteristics of the Participants

Characteristics	Water Exercise (W, n = 7)	Land Exercise (L, n = 5)
Gender		
Male (n)	3	0
Female (n)	4	5
Age, mean yrs (SEM)	67.7 ± 3.4*	76.8 ± 1.3
Glasses (n)	7	5
Joint Pain (n)	4	3
Orthopedic Surgery (n)	3	1
% Attendance (SEM)	81 ± 0.05	72 ± 0.05

*significant $p < .05$ from L

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significant difference in the age (range 57–80 years) of the participants with the W group (67.7 ± 3.4 years) being slightly younger than the L group (76.8 ± 1.3 years). In the final analyses using the 2 × 2 factorial ANOVAs, no significant group effects for any of the dependent variables were found, thus an analysis of covariance with age used as a covariate was not done.

The relationships among balance tests (means ± *SEM*) for the W and L exercise groups are shown in Table 2. Comparisons of means for equivalence at baseline between the W and L groups were performed using independent *t* tests and there were no apparent differences on any of the dependent variables for the two groups. Using 2 × 2 ANOVAs there was a significant repeated measures main effect of time between pre and posttest scores for both W and L groups on functional reach, $F(1,10) = 20.98$, $p = 0.001$; timed "up & go," $F(1,10) = 9.10$, $p = 0.013$; step test right leg, $F(1,10) = 42.09$, $p < .001$; step test left leg, $F(1,10) = 43.42$, $p < .001$; and the 6-min

Table 2 Pre- and Post-Test Balance Scores for W and L Groups

	Water Exercise (*N* = 7)		Land Exercise (*N* = 5)		ANOVA
	Pre	Post	Pre	Post	Time
Functional Reach (in)	9.45 ± 0.82	12.68 ± 1.14*	8.61 ± 1.46	10.80 ± 1.06*	F(1,10)= 20.98, P = .001
Tandem Gait (steps)	5.81 ± 1.54	6.57 ± 1.38	4.80 ± 1.61	6.53 ± 1.22	F(1,10) = 2.84, P = .123
Timed "Up & Go" (sec)	9.99 ± 2.18	7.26 ± 1.60*	6.92 ± 0.22	6.11 ± 0.25*	F(1,10) = 9.10, P = .013
Step Test (steps)					
Right Leg	16.23 ± 2.66	21.33 ± 2.59*	16 ± 2.04	22.39 ± 1.36*	F(1,10) = 42.09, P < .001
Left Leg	15.57 ± 2.65	20.33 ± 2.47*	15.8 ± 2.20	22.6 ± 1.05*	F(1,10) = 43.42, P < .001
One-Leg Stance (sec)					
Right Leg	14.84 ± 3.93	13.16 ± 4.62	16.35 ± 2.94	15.9 ± 5.34	F(1,10) = 0.29, P = 0.600
Left Leg	16.21 ± 5.05	16.47 ± 4.71	13.57 ± 5.38	14.18 ± 5.61	F(1,10) = 0.17, P = 0.689
Eyes Closed Right Leg	3.23 ± 0.85	4.9 ± 1.50	3.97 ± 1.56	2.55 ± 0.61	F(1,10) = 0.04, P = 0.854
Eyes Closed Left Leg	3.93 ± 0.75	5.29 ± 1.64	3.36 ± 0.96	2.22 ± 0.29	F(1,10) = 0.01, P = 0.907
6-Minute Walk (meters)	501.43 ± 44.32	552.48 ± 43.46*	429.05 v 19.69	494.14 ± 28.04*	F(1,9) = 48.64, P < .001

*significant from pretest. alpha < 0.05.

walk, $F(1,9) = 48.64$, $p < .001$). Both groups showed no significant time effects in tandem gait or the one-leg stance from pre to posttest measures. The main effect of group was not significant for any of the balance scores; moreover, there were no interaction effects between time and group on any of the dependent measures.

Given that the analyses in this study consisted of 10 ANOVAs there was a fear of an inflated alpha or Type I error. To control for this, the Bonferroni correction was used. This method is very conservative and consists of dividing alpha by the number of statistical tests performed. Starting with alpha = 0.05 and 10 statistical tests, the resulting critical value for significance becomes $p = 0.005$ (0.05/10). After applying this method, all tests remained significant except for timed "up and go" ($p = 0.013$), which becomes significant only if no Type I error experiment-wise inflation is presumed.

Discussion

The primary purpose of this pilot study was to compare the potential effectiveness of water- and land- based balance specific training on functional balance in older adults. This study found that balance improved in response to training programs in both the water and on land for four of the assessment measures, including the functional reach, timed "up & go," step test, and the six-minute walk (Table 2). No significant differences were found in any of the assessment measures between the experimental and control groups. This suggests that similar improvements in balance can be made regardless of whether water or land mode training is used. No differences were observed despite the fact that the W group only had two balance-specific sessions per week in comparison with the three by the L group.

Previous studies have identified the positive benefits of both water- and land-based exercise. Simmons and Hansen (1996) examined the effectiveness that water- and land-based exercise programs had on functional reach. In their study, four randomized groups of elderly subjects (water exercisers, land exercisers, water sitters, and land sitters) exercised two times a week for 5 weeks; at the end of the training period, two of the groups (water exercisers and land exercisers) improved their forward reach. In 2001, Shono, Fujishima, Hotta, Ogaki, and Ueda reported consistent findings of improved balance in community dwelling women who were randomly divided into an aquatic exercise and a land-based gymnastic-type program. Their results showed no significant difference between the ability of the two groups to complete a 10-m long obstacle-walking test (water exercisers = 6.2 s versus gymnastic exercisers = 6.3 s), contributing to the literature that results from land and water exercise modes may produce roughly equivalent results. In yet another study, Douris and colleagues (Douris et al., 2003) found improvements in balance utilizing the 14-item Berg Balance Scale when comparing participants exercising on land and in water pre and postintervention. No significant differences between water- and land-based exercise groups were reported. Their data implied that as long as programs have similar intensity, duration, and frequency, the differences between water- and land-based exercise programs are minimal.

Recently, Melzer and collaborators (Melzer, Elbar, Tsedek, & Oddsson, 2008) described a detailed aquatic exercise protocol that emphasized the importance of balance-specific training by using a variety of ambulatory and balance activities.

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In our study, we used the exercise specificity emphasis of Melzer et al. (2008) and found that the balance training protocols were as effective in water as on land. For example, the values for functional reach in our study increased on average 3.2 inches for W and 2.19 inches for L from pre to postassessment. Moreover, the timed “up & go” scores decreased significantly for each group. W changed from 9.99 ± 2.18 s in the pretest to 7.26 ± 1.60 s at the posttest for a decrease of 2.73 s while L began with 6.92 ± 0.22 s and ended at 6.11 ± 0.25 s for a decrease of 0.81 s. Step test measures increased in both legs from pre to posttests with the average number of additional steps made posttest being W 5.1 steps, L 6.39 steps for the right leg and W 4.76 steps, L 6.8 steps for the left leg. The distance participants walked in the six-minute walk test (Table 2) was similar to the 440–507 m range as reported by Steffen et al. (2002).

Although improvements have been reported for many physiologic measures from both water and land exercise training, exercise in the water environment may have added benefits, especially for older adults. Benelli, Ditroilo, and De Vito (2004) analyzed the difference between heart rate and blood lactic acid levels in land- and water-based aerobic exercise groups at comparable intensities. The land aerobics group had significantly higher heart rates and blood lactic acid values than the water aerobics group. These findings suggest that the less demanding nature of the aquatic environment may be a better mode of training for elderly populations who commonly present with multiple health conditions. Impairments such as clinical disease, gait and balance abnormalities, joint pain, and decreases in vision make land exercise more challenging for many older participants. Of the 12 participants in our study, 33% had had orthopedic surgery, 58% reported joint pain, and 100% wore glasses according to responses from the general health questionnaire administered at the beginning of the study (Table 1).

Water-based exercise programs may also be more beneficial than conventional land- based exercise programs for the elderly because of the safer and more supportive exercising environment that is created by the water. For instance, one potential negative issue associated with exercise on land for this population is related to the fact that increased activity levels increases the risk of falls. Moreover, because between 30% and 73% of older adults acknowledge a fear of falling, the safety of the aquatic environment eliminates the risk of falling during exercise (Podsiadlo & Richardson, 1991). Due to the supportively buoyant environment of the water, participants are able to accomplish skills in the water that would be difficult, too painful, or impossible to perform on land. For these reasons, the water exercise mode may improve exercise compliance. In fact, our results on attendance (Table 1) for the eight-week balance-training program produced slightly higher attendance in the W group (81%) compared with the L group (72%). Of course, these are simply descriptive statistics without a test of significance.

Lastly, as the evidence of our pre and postfunctional balance results showed balance improvements that were made in the water transferred to improvements on land. (Note: all tests were performed on land.) Therefore, we conclude water is an important medium to consider for exercise in older adults due to the less demanding nature and the safer environment of the water. We also concluded that improvements in functional balance that are realized in the water are similar to those improvements that we found on land.

Limitations

Limitations of these preliminary data include lack of participant randomization into the W and L exercise groups. All participants had self-selected into the W or L exercise group predominantly based on preexisting health conditions. For example, there were more individuals in the W exercise group who reported on their general health questionnaire that they had had orthopedic surgery than did those participants in the L exercise group (Table 1). To better ensure that the participants were equivalent at baseline on the balance indicators, all participants had been exercising (standard water exercise and land exercise classes with no balance training) in their respective environments at least one month before the pretests. Based on independent *t* tests, participants did not significantly differ on any of the balance measures at baseline so participant self-selection into the W and L exercise groups did not appear to affect the results. It is possible that the lack of between-group differences in the 2 × 2 ANOVAS conducted on each balance measure occurred due to small sample sizes of the W and L groups and possibly low statistical power to discern significant differences. In the future, larger sample sizes need to be recruited to increase the statistical power of the study to detect differences between the groups, if any exist. In addition, in the future, a priori statistical power needs to be calculated to know in advance the meaningful effect sizes. The fact that the W exercise group only received balance specific training in two out of their three exercise sessions each week compared with the L exercise group that received the balance training in all three of their exercise sessions each week could have explained why there were no group differences in balance. This is unlikely because the third exercise session for the W participants included other parameters that are known to enhance balance such as cardiovascular fitness, strength, and flexibility (Taunton et al., 1996). Moreover, based on the studies reviewed earlier that compared various balance indicators in water-based and land-based exercise programs, the balance results found between the groups were similar regardless of whether the exercise occurred in the water or on the land (Douris et al., 2003; Shono et al., 2001; Simmons & Hansen, 1996).

Conclusions

Few studies have examined the effectiveness of water and land exercise that specifically challenge and train functional balance. The results of our small sample, preliminary study found that both the water and land exercise groups improved significantly on four functional balance tests after completing the intervention programs. These data suggest water- and land-based exercise programs that specifically train balance produce similar outcomes on many balance tests. Moreover, we concluded that for those individuals who have a "fear of falling" or other chronic pain that prohibits land exercise, water may be a beneficial mode of exercise for older adults due to the less demanding effects water exercise has on the body and the support and buoyancy of the water environment. By creating a specific program targeted at challenging and improving balance, a small sample of older adults were able to transfer gains made in the water to functional balance assessments on land. Because balance is an important predictor in preventing falls and a component in maintaining mobility in older adults, future studies should be conducted using a

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longer study duration and further investigate and potentially replicate these results by employing larger and randomized exercise groups. Subsequently, balance-specific water exercise programs should be part of fall prevention intervention programs.

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