

Background

Falls in the older population are commonly linked to gait and balance inconsistencies influenced by a combination of physiological (e.g. sarcopenia) changes and declines in sensory and central sensory integration. With aging, there is a decline of muscle mass and muscle quality, thus greatly affecting both physiological and neuromuscular function. Older individuals are, therefore, at a greater risk for decreased functional performance and issues with coordination, balance, and mobility; hence, their potential risk for falls is also increased.

There is a strong association between lower body muscle strength, power, and force and fall risk. Having greater strength, power, and muscle force improves balance and mobility, and are important for situations when balance needs to be quickly adjusted after a stumble or a trip. Several fall prevention strategies have received notable attention including physical activity interventions and fall risk assessment. However, as evident by the variety of programs available and the wide range of program durations (8 weeks to 52 weeks), session frequencies (e.g. 2-7 days/week), intensities, and session durations (e.g. 20-90 min.), questions surrounding the most effective mode to address fall prevention still exist.

Short-term multi-component dynamic training methods have been used extensively in sports settings to improve strength, power, and force in younger athlete populations. The 'athlete' model traditionally incorporates bouts of high intensity challenging activities (e.g. agility, balance, and change of direction training) that target specific muscle groups. However, despite its effectiveness in developing the major variables that influence functional performance, there is a paucity of research investigating this type of training model and fall prevention in older individuals.

Purpose: The purpose of the following study was to examine the effect of high intensity short-term multi-component land and aquatic training in older adults.

Phase 1 & 2: Land & Aquatic

Seventy-three (n = 73; Land: 48; Aquatic: 25) healthy women and men (ages 55-90 yrs.) were included in the program. The 8-week progressive intervention consisted of specialized small group exercise training, 3x per week for 45-minutes per session. Training consisted of lower body body-weight strength exercises (e.g. squats, modified lunges), specialized change of direction, range of motion movements, and static and dynamic balance exercises.

Pre/Post Study Assessments:

- **Basic Anthropometry:** Body mass in kilograms was obtained (to the nearest 0.1 kg) using a certified electronic scale. Standing height was obtained using a standard wall-stadiometer to the nearest 0.1 cm.
- **Force and Endurance (Sit-to-Stand):** Sit-to-stand efficiency was assessed using a standardized 30-second sit-to-stand test. Muscle-force (Peak, Relative Peak, and Peak Power) was obtained using a calibrated Bertec® force plate.
- **Leg Strength (Leg Extension):** Participants performed a 10-repetition test (10-RM) on a leg extension exercise machine using the established National Strength and Conditioning Guidelines (NSCA, 2015).
- **Gait:** Walking time was assessed using the Walking Alternate Directions item from the Bruininks Motor Ability Test.
- **Lean Mass:** Changes in lower body lean mass was assessed via Dual Energy X-ray Absorptiometry (DXA)
- **Balance:** Stationary and dynamic balance was assessed using the Balance Subtest of the Bruininks Motor Ability Test (BMAT).
- **Confidence:** Changes in confidence performing activities of daily living (ADL) was assessed using The Activities-specific Balance Confidence (ABC) Scale.

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The Mindful Movement Program

The Mindful Movement Program uses progressive, skill appropriate performance-related exercise to promote health by increasing physical strength and balance and improving confidence and self-efficacy; all within a safe, inclusive, and supportive environment.

Results

Descriptive Statistics

- No significant differences were observed in body mass and BMI
- No significant differences were observed in body fat%
- 44% of participants had single or multiple joint replacements
- Included Clinical Conditions: Parkinson's, Pulmonary Fibrosis, Diabetes, Cancer Remission, Multiple Sclerosis, Peripheral Neuropathy, Crohn's Disease

Results

Performance Outcomes: Land & Aqua (TABLE 1)

Following the 8-week intervention, Pre/Post results (Land and Aquatic):

- Significant increases in combined grip strength pre/post ($p < 0.001$)
- Significant increases in sit-to-stand efficiency ($p < 0.001$)
- Significant increases in force (N) during sit-to-stand ($p < 0.05$)
- Significant increases in leg extension performance (kg) ($p < 0.001$)
- Significant reduction in walking time ($p < 0.001$)
- Significant increases in balance scores ($p < 0.001$)
- Significant improvements in confidence performing ADL's ($p < 0.01$)
- Program completion rate (Land and Aquatic): ~98%

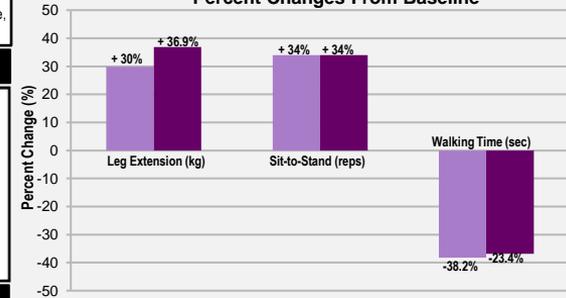
TABLE 1: Performance Outcomes-Land and Aquatic

	Pre: Land	Post: Land	Pre: Aqua	Post: Aqua
Sit-to-Stand Efficiency (reps)	16.5 (5.8)	21.5 (5.9)	14.4 (4.8)	19.3 (4.1)
Leg Ext. Performance (kg)	23.5 (6.5)	30.0 (7.8)	30.9 (11.8)	42.3 (12.7)
Balance	25(4.4)	27(3.0)	22.4 (3.5)	25.6 (2.4)
Walking Time (sec)	16.15 (3.0)	9.82 (2.1)	14.68 (2.6)	11.24 (1.7)

Values expressed as means (SD)

Results

Percent Changes From Baseline



Summary

Falls are a significant concern in older populations. Therefore, effective fall prevention programs are increasingly essential for supporting safe and connected communities. For years, dynamic models have been successfully implemented to improve strength and balance in younger athletic populations. However, very few current fall prevention programs incorporate dynamic movements. The purpose of our study was to examine the efficacy of using a specialized dynamic exercise model on variables that directly influence fall risk for individuals of older ages and differing abilities. Our primary findings suggest that intense dynamic resistance training can be an effective method to address fall risk in older populations.

- Pre/post comparisons revealed significant increases in lower body strength in both sit-to-stand and leg extension tests.
- Data shows trending increases in lower body lean tissue (g).
- Strength increases likely influenced both balance and walking scores.
- Feedback via post intervention focus group revealed the small group setting greatly influenced program completion, individual improvements, and confidence.
- Limited data is available on Aquatic Training and strength for older adults. Our data suggests that the aquatic environment can be a suitable alternative to traditional land-based programs, therefore, potentially increasing accessibility to this type of fall prevention training model.

Statistical Analyses

- Pre/Post mean differences were analyzed using Paired T-tests
- Significance = $p < 0.05$