



Improved Functional Performance in Individuals with Dementia Following a Moderate-Intensity Strength and Balance Program

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INTRODUCTION

Individuals with dementia (IWDs) experience a wide range of difficulties due to the neurodegenerative pathology that impacts both cognitive and functional domains. These challenges may result in functional limitations and disability that can burden the individual, caregivers, and society. Interventions aimed at improving these outcomes may lessen secondary ramifications experienced due to the dementia, such as falls or institutionalization. With many positive findings having been identified in healthy older adults, research questions have arisen to determine whether exercise can be used as an efficacious intervention to assist individuals with dementia (IWDs). Exercise could be an excellent adjunct or alternative to current interventions; however, there is limited and mixed evidence in the current body of literature regarding the use of exercise with IWDs. Limitations in the current research warrant further study to determine the effects of exercise with IWDs. The purpose of the current study was to develop and evaluate the effects of a moderate-intensity home-based functional exercise program for IWDs.

METHODS

Research Design

The current study was a randomized, controlled intervention trial with a two-group pre-test and post-test design. **Outcome measures** included fidelity measures to ensure that adequate dosage was delivered to the participants and several measures to assess efficacy that included Trail Making Test – Part B (executive function), 30-second chair stand (LE strength), modified Berg Balance Scale (balance, and 8-foot walk test (comfortable and fast gait speed).

Multiple **linear regression analyses** were used to test efficacy of the intervention on each outcome measure. The key independent variable was a dichotomous variable representing assignment into the intervention or comparison group. The baseline value for the targeted dependent variable was included in the regression equation to control for baseline performance in order to examine change over the 12-week period. Significance level was set at 0.05.

Intervention Group

The intervention was a home-based exercise program consisting of two main components (moderate-intensity functional strength and balance exercises). Principles from exercise science (Mueller & Maluf, 2002; vanBeveren & Avers, 2012) and the Strength-Based Approach were used as overarching frameworks for the development and implementation of the protocol. The Strength-Based Approach was used to address the cognitive and functional needs of IWDs (Judge et al., 2010; Orsulic-Jeras et al., 2003), making the protocol a novel and innovative approach to exercise with this population.

The strength and balance program was delivered in the participant's home by a trained practitioner two times per week lasting 12 weeks, for a total of 24 sessions. Initial starting exercises were determined from baseline walking performance as developed by Littbrand et al. (2006) for the HIFE protocol (see Table 1). The practitioner and participant chose exercises based on his or her individual needs and preferences. The goal for each session was completion of two functional strengthening activities and two balance exercises.

Table 1. Recommended Initial Exercise Categories

Physical Function Group ^a	Recommended Categories in the Collection of Exercises
Walking without any physical support or supervision	A. Static and dynamic balance exercises in combination with lower-limb strength exercises
	B. Dynamic balance exercises in walking
Walking with supervision or minor physical support from 1 person	A. Static and dynamic balance exercises in combination with lower-limb strength exercises
	B. Dynamic balance exercises in walking
	C. Static and dynamic balance exercises in standing
Walking with major physical support or not able to walk	C. Static and dynamic balance exercises in standing
	D. Lower-limb strength exercises with continuous balance support
	E. Walking with continuous balance support

Participants

The sample consisted of 23 IWDs with mild to moderate cognitive impairment with an average MMSE of 20.83 (intervention group: n=13, comparison group: n=10). These were community-dwelling older adults, which were 56.5% female with a mean age of 73.86 years.

Participant Characteristic	Sample (N=23)		Intervention (N=13)		Comparison (N=10)	
	Mean	SD	Mean	SD	Mean	SD
Age (range = 53-92 years)	73.86	9.13	73.78	8.50	73.96	10.37
MMSE (range = 9 - 28)	20.83	5.02	19.92	6.10	22.00	3.06
Chronic health conditions (range = 1 - 7)	4.04	1.85	4.15	1.95	3.90	1.79
GDS-short form (range = 0 - 16)	5.61	5.59	5.38	6.10	5.90	5.15
Exercise minutes per week (range = 0 - 350 minutes)	69.78	93.3	90.38	101.00	43.00	79.17
Self-rated health	2.17	0.72	2.31	0.75	2.00	0.67
TMT-B (time)	4:36	2:29	4:27	2:01	4:44	2:57
Gait speed (comfortable, m/s)	0.67	0.21	0.69	0.18	0.65	0.24
Gait speed (fast, m/s)	1.29	0.44	1.24	0.27	1.35	0.62
Chair stand test (reps)	14.74	5.86	14.0	5.82	15.70	6.08
m-BBS (max 44)	39.04	5.71	39.46	3.31	38.50	8.03
ADL scale (max 48)	5.86	5.51	7.25	6.43	4.20	3.85
	%		%		%	
Female	56.5%		46.2%		70.0%	
College graduate	47.8%		38.5%		60%	

Note. MMSE = Mini Mental State Exam. For MMSE, higher scores indicate higher levels of functioning with maximum score of 30. GDS = Geriatric Depression Scale. For GDS, higher scores indicate more depressive symptoms with maximum score of 45. For Self-rate Health, 0 = poor, 1 = fair, 2 = good, 3 = excellent. TMT-B = Trail Making Test – Part B. For TMT-B, longer time to complete indicates lower executive function. For chair stand test, more repetitions completed indicate better lower extremity strength. m-BBS = modified Berg Balance Scale. For m-BBS, higher score indicates better balance. ADL = activities of daily living. For ADL scale, 0 = "no difficulty", 1 = "little difficulty", 2 = fair amount of difficulty, 3 = "very difficult" for 16 items with maximum score of 48. No significant differences were noted between groups on demographic or baseline performance variables, p=.05

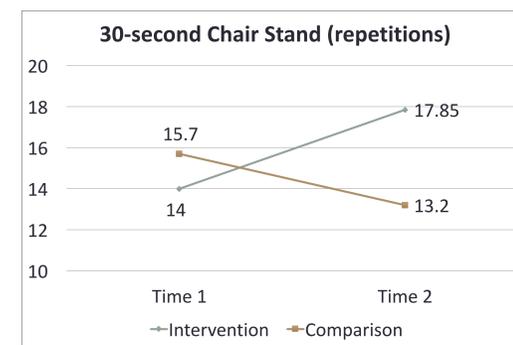
RESULTS

Intervention Fidelity

Over 94% of all sessions were completed within the prescribed exercise categories based on their assigned Physical Function Group (see Table 1) indicating a high level of fidelity to the protocol. Following a 2-week acclimation period, participants should have completed strengthening exercises at 8 to 12 RM and balance exercise for a 1-minute period. On average, participants performed strength exercises at 11.67 RM ($SD=1.46$) and balance exercise for a period of 59.98 seconds ($SD=0.09$) indicating good fidelity to the protocol.

Efficacy Testing

Executive function. It was hypothesized that participants in the intervention would demonstrate significant improvement in executive function. This hypothesis was not supported in the current study. Results indicated that assignment to the intervention or comparison group **did not significantly predict** performance on the TMT-B at Time 2 ($t=0.55, p=.59$).

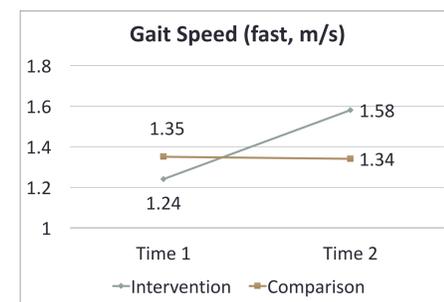
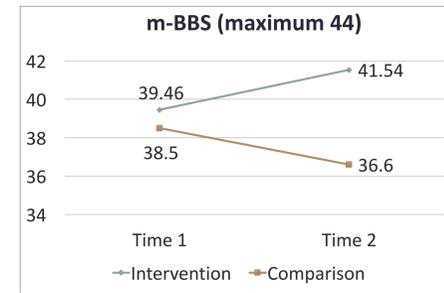


Balance. It was hypothesized that participants in the intervention would demonstrate significant improvement in balance scores. Significant results were found supporting hypothesis 2, with participants in the intervention group **demonstrating improved balance** compared to comparison group participants.

LE strength. It was hypothesized that participants in the intervention would demonstrate significant improvement in lower-extremity strength. Assignment to the intervention group **predicted significantly higher performance** during the follow-up assessment ($t=3.26, p=.004$). Unstandardized regression coefficients show an average of 5.92 more repetitions completed by the intervention group.

Unstandardized regression coefficients show an average of 4.04 points improvement for the intervention group at Time 2 ($t=4.13, p=.001$).

Gait speed. It was hypothesized that participants in the intervention would demonstrate significant improvement in both comfortable and fast gait speed. Partial support was found for this hypothesis. Assignment to the intervention or comparison group **did not significantly predict comfortable gait speed** at Time 2 ($t=0.55, p=.59$). However, participants in the intervention group **demonstrated significantly better fast gait speed** after 12-weeks ($t=2.61, p=.02$). Unstandardized regression coefficients show an average of 0.32 meters per second improvement was found in fast gait speed for intervention group participants.



DISCUSSION

The exercise program demonstrated efficacious effects on balance, lower-extremity strength, and fast gait speed for the sample of IWDs. The program consisted specifically of functional lower-extremity strength and balance activities; therefore, these are the outcomes that should demonstrate a high level of improvement. Gait speed can be described as a function of strength and balance; therefore, improvements in fast gait speed are most likely due to the contributions of strength and balance gains.

Clinical Relevance

Participants demonstrated very high levels of tolerance to the moderate-intensity functional exercise program along with the ability to successfully complete the protocol. Delivering exercise at an adequate dosage resulted in positive functional outcomes including increased strength, balance, and fast gait speed. There may be a belief that older adults are unable to tolerate activity at higher levels; therefore, rehabilitative professionals may feel the need to exert an over-abundance of caution to prevent injury or may believe that the individuals cannot perform above a certain level. It is imperative for researchers and clinicians to ensure that an exercise intervention is being implemented properly to optimize the benefit for the individuals. These results highlight the need to implement evidence-based protocols that are grounded in research and science. This study provides promising results of the benefits of using a Strength-Based Approach when working with IWDs along with utilizing a moderate-intensity strength and balance protocol. Future research should examine the long-term effects of this type of exercise program along with additional primary and secondary outcomes, such as well-being, falls, and potential benefits for the caregiver.

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