Accepting the Challenge—Moderate-Intensity Exercise with Individuals with Dementia: A Case Series

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ABSTRACT

BACKGROUND AND PURPOSE: The global impact of dementia demands a response from researchers and clinicians to not only assist with prevention and a cure, but also to assist in the management of symptoms related to this progressive disease. The purpose of this case series is to highlight the participation of 3 individuals with varying levels of dementia in a moderate-intensity functional exercise program.

INTERVENTION: The intervention, developed using principles from exercise science and a Strength-Based Approach, consisted of 24 sessions of moderate-intensity exercises delivered in participant's home.

OUTCOMES: Each participant completed a pre- and post-assessment including gait speed, strength, balance, depressive symptoms, cognition, and perceived difficulty with activities of daily living. Despite various clinical presentations, each participant successfully completed all 24 sessions with noted improvements in at least two measures.

DISCUSSION: These findings highlight the flexibility of using the Strength-Based Approach to enhance participation in a standardized exercise program.

KEYWORDS: cognitive impairment, physical activity, strength, balance

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Introduction

Worldwide, an estimated 48.6 million individuals lived with dementia in 2015, with numbers doubling every 20 years to 131.5 million in 2050.[1] Individuals with dementia (IWDs) experience cognitive and functional deficits, as well as declines in psychological well-being. Most dementias result in slow and steady decline over several years, resulting in the potential for increased dependence on caregivers as well as cost to the healthcare system with worldwide costs of US$818 billion in 2015.[1] By the age of 80 years, 75% of individuals with Alzheimer's disease, which is the most common dementia type, will require placement in a long-term care facility as opposed to 4% of the general population.[2] The global impact of dementia demands a response from researchers and clinicians to not only assist with prevention and a cure, but also to assist in the management of symptoms related to this progressive disease. There is no cure for dementia and no evidence that the current medication regimens effectively halt the progression of the illness; therefore, there is a need for efficacious non-pharmacological intervention protocols that facilitate IWDs' independence and psychosocial well-being. Exercise programs (eg, walking, swimming, weight-lifting, balance) are one such example of non-pharmacological interventions that may be extremely effective in maintaining independence, improving psychosocial well-being, and supporting physical and cognitive health. In addition, many exercise programs are inexpensive, easily accessible, and allow participation by IWDs later into the disease process. However, few studies to date have evaluated exercise programs developed specifically for IWDs.

Moderate-intensity exercise has been found to differentially affect multiple domains including cognition,[3] functional status,[4] as well as various aspects of psychological well-being[5] in both healthy older adults and those with dementia. IWDs have a higher rate of functional mobility problems and falls.[6–8] These mobility problems are usually related to functional limitations such as gait and balance, which can be common in older adults with cognitive impairment.[6,7,9,10] These deficits in functional mobility, balance, and gait can be partially responsible for declines in functional performance, institutionalization, and the increased risk of falls.[7,11,12] Identifying strategies to combat these declines is crucial in maximizing a person's independence and optimal participation in daily activities. Improvements in domains of strength, balance, and gait may reduce dependence on caregivers as well as delay or prevent the need for transfer into a long-term care facility. For example, gait cadence has been found to predict falls in patients with Alzheimer's disease[11] while walking speed has been found to be associated with transfer from assisted living residence to a skilled nursing facility;[12] therefore, it is possible that improvements in walking speed through exercise could allow an IWD to "age in place" longer.

From a rehabilitation perspective, issues pertaining to fall risk, gait speed, balance, and strength are specifically addressed

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by physical therapists. Moreover, physical therapists are experts in movement science and exercise prescription; therefore, they play a pivotal role in assisting in the proper implementation of an exercise program with IWDs. However, IWDs can pose unique challenges to physical therapists due to the changes in cognitive function associated with the neurodegenerative illness. Therefore, it is imperative for physical therapists to possess the necessary skills to best serve this patient population.

A key factor identified as relevant to the success of rehabilitation outcomes is the role of patient participation. Specifically, research has found rehabilitation participation mediates the relationship between cognitive impairment and rehabilitative outcomes.[13] This is an extremely important finding giving that IWDs may not be able to self-motivate and/or engage in complex rehabilitation programs that require new learning due to their cognitive impairment. Therefore, it is crucial that researchers and clinicians identify the best practices in facilitating optimal levels of participation for IWDs throughout the continuum of care, especially in the rehabilitation process. IWDs would benefit the most from exercise programs that (1) target IWDs' specific rehabilitation needs; (2) incorporate strategies that mitigate the impact of cognitive impairment; and (3) facilitate active participation and engagement.

The purpose of this case series is to highlight the participation of 3 individuals with varying levels of cognitive impairment in a moderate-intensity strength and balance functional exercise program that was developed using principles from exercise science[14,15] and the Strength-Based Approach.[16,19] Principles from exercise science were used to ensure IWDs received the adequate dosage necessary for improvement. The Strength-Based Approach was implemented to address the unique needs of IWDs, including reducing barriers associated with cognitive impairment (ie, reliance on short-term memory); facilitating exercise goals by utilizing intact cognitive processes (ie, procedural memory); and maximizing engagement and participation. The Strength-Based Approach provides researchers and clinicians a framework for understanding and identifying the remaining abilities of IWDs[16] and how to maximize successful outcomes in the domain of physical performance.[17,18]

Case Description

Participant history

Each of the 3 participants discussed in this case series lived in the community with their spousal caregiver and had been diagnosed with Alzheimer's disease. Participants were referred to the research project through involvement with local chapters of Alzheimer's Association and were randomly assigned to the intervention condition (for results of the randomized control trial, please see [Dawson et al., 2019]).[17] Participant characteristics are summarized in Table 1. These participants were chosen for this case series due to the varying characteristics in age, gender, physical stature and condition, and cognitive status. Individuals did not have any musculoskeletal or neuromuscular conditions that would preclude them from participating in a moderate-intensity exercise program. Participants' primary care physicians were notified of participation in the program.

The participant in Case 1, a 79-year-old woman with mild symptoms of dementia (Mini-Mental State Examination [MMSE] = 22), lived with her husband in a single-story condominium. She reported that she used to walk a lot for recreation but does not as much anymore, but her husband loves to ride his bike around the neighborhood. She reported not participating in any regular exercise the month prior to the program. She was still able to care for herself and assisted her husband with shopping, cooking, and cleaning activities as his physical health was not the best. She was very social and loved to visit with family in the area. The participant depicted in Case 2, a 75-year-old male with severe symptoms of dementia (MMSE = 11), lived with his wife in a single-story home with a basement and required constant assistance for all of his basic activities of daily living (ADLs) due to his cognitive status. He enjoyed watching sports and working on puzzles with his wife. His wife reported some occasional wandering behavior and difficulties attending to tasks. She was still able to take him with her on shopping trips and out to restaurants. He attended a day program for IWDs a few times per week and participated in approximately 20 min/week of regular exercise in the month prior to the study. The participant in Case 3, a 63-year-old male with moderate symptoms of dementia (MMSE = 17), lived in the community with his wife in a single-story home. He was still very active in the community and had a newborn grandson who lived nearby. He reported working out approximately 120 min/week at the local senior center including weight training. He still golfed with his friends, tended to the garden at home, and traveled to see his family in other states.

Baseline assessment

A physical assessment was completed for each participant prior to initiation of the moderate-intensity exercise intervention including comfortable and fast gait speed via the 8-foot walk test,[20,21] lower extremity via 30-s chair stand test,[22–24] and balance via the modified Berg Balance Scale (m-BBS).[6,12] In addition, each participant completed the Geriatric Depression Scale (Short Form)[25,26] to examine depressive symptoms and the Trail Making Test—Part B (TMT-B)[27,28] to assess executive function. Finally, each participant completed a 16-item self-report tool[29–31] to assess their perceived difficulty with both instrumental and personal ADLs. Baseline performance is summarized in Table 1.

Overall, at baseline, these participants demonstrated minimal to no deficits in strength[24] and balance; however, all had comfortable and fast gait speeds that were well below published normative data for age and gender.[20] At baseline, none of the participants revealed depressive symptoms above the recommended cut-off of 5 points.[26] Two (cases 2 and 3)

Table 1. Participant information.

	CASE 1		CASE 2		CASE 3	
	BASELINE	FOLLOW-UP	BASELINE	FOLLOW-UP	BASELINE	FOLLOW-UP
Age (years)	79		75		63	
Gender	Female		Male		Male	
Height (in)	62		N/T		72	
Weight (kg)	46.2		N/T		96.2	
MMSE, max 30	22		11		17	
Health conditions	6		1		1	
Self-rated health	3	2	1	1	2	3
Geriatric Depression Scale (Short Form)	2	10	4	1	2	7
Trail Making Test (B)	2:47	7:39	Unable	Unable	Unable	21:29
Gait speed, comfortable (m/s)	.66	.58	.88	.59	.78	.86[a]
Gait speed, fast (m/s)	.98	1.48[a]	1.33	1.69[a]	1.41	2.41[a]
Chair Stand Test (reps)	15	17[a]	15	11	32	35[a]
Modified Berg Scale, max 44	44	44	37	42[a]	44	44
Perceived ADL Scale, max 48	13	10	0	1	13	13

Abbreviations: ADL, activities of daily living; MMSE, Mini-Mental State Examination; N/T, not tested.
Self-rated health = 0 (poor) to 3 (excellent).
[a]Clinical meaningful change in performance.

participants were unable to complete the TMT-B due to their cognitive limitations while case 1 completed the TMT-B in 2 min and 37 s indicating no significant deficits in her executive function at baseline. All participants had different perceptions of their overall health, ranging from 0 being "poor" to 3 being "excellent," while all perceived minimal to no difficulty with their ADLs.

Intervention

The intervention was a moderate-intensity home-based functional exercise program consisting of strength and balance exercises.[18] The functional strength and balance program was delivered individually in the participants' home by a board-certified geriatric physical therapist twice weekly for 12 weeks. Each session was composed of 4 elements: (1) *Review*, which examined results from previous sessions and identified of barriers to exercise completion reported by caregiver or IWD; (2) *Education*, which initially outlined the purpose of the intervention and provided subsequent education to improve adherence; (3) *Planning* allowed the utilization of available implementation strategies, based on the Strength-Based Approach Judge et al.,[16] to overcome barriers reported by the IWD or caregiver; and (4) *Activity*, which delivered a tailored functional strength and balance program based on the participant's functional status. The development of the intervention protocol was guided by principles from exercise science[14,15] and the Strength-Based Approach Judge et al.,[16] allowing for a structured, standardized intervention protocol that is flexible to the needs of the individual participant each session. In the larger study, the intervention was found to be highly acceptable and feasible by the participants and the exercise practitioners via adherence, tolerance, and individual session evaluations highlighting engagement, fidelity to the protocol, confidence, and enjoyment.[17,18] This was consistent from the beginning of the intervention throughout the 12 weeks.

Initial starting exercises were determined by placing participants in a Physical Function Group based on initial walking performance as developed by Littbrand et al. (see Table 2). All 3 participants were placed in Physical Function Group 1 throughout the intervention, which indicated they could "walk without any physical support or supervision." The therapist and participant chose initial starting exercises based on this initial performance. Due to the high-level baseline of each participant, the exercise categories included higher level functional exercises (Categories A and B) to challenge the participant. Category A included static and dynamic balance exercises in combination with lower-limb strength exercises, such as step-ups, sit to stand, forward or side lunges. Category B included dynamic balance exercises while walking, such as stepping over obstacles, tandem walk, tossing ball in air while walking.

Table 2. Physical Function Group and 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

[a]The participant's need for personal support when walking a short distance (5-10 m) without walking aid.[29]

Table 3. Use of implementation techniques based on Strength-Based Approach.

STRENGTH-BASED APPROACH TECHNIQUE	POTENTIAL BARRIERS	COGNITIVE STRENGTH BEING USED	EXAMPLE OF APPLIED TECHNIQUE
Keeping it short and simple (KISS)	Frustration; inability to complete activity properly	Procedural memory; language comprehension	Reducing verbal cuing during instructions
			Eg, "Get up off of the floor" instead of "Roll over on your side and use your right hand and forearm to push up from the floor so you can stand up"
External memory aids	Poor adherence despite willingness to participate; repetitive questions or demonstration	Simple attention; reading	Use of calendars; use of written instructions for exercises; use of visual cues (spots) for foot placement
Learning by modeling	Frustration; inability to complete activity properly	Procedural memory; visuospatial functioning	Demonstrating activity with participants instead of relying on verbal cues only
Allowing IWD to choose activity	Boredom; poor adherence	Procedural memory	Giving IWD choice of 2 possible activities
Using familiar activities or hobbies in exercise	Boredom; poor adherence; inability to complete activity properly	Procedural memory	

Abbreviation: IWD, individual with dementia.

To account for needs of this special population, strategies from the Strength-Based Approach were included in the protocol design to enhance the implementation of the intervention (Table 3). A few examples of these strategies within these 3 cases included using an external memory aid (dots on floor) to assist with foot placement during a lunge exercise; always giving the individual a choice of 2 exercises to allow them to choose a more preferred activity (eg, "would you rather do step-ups or sit to stand this time?"); cuing using one- to two-step commands such as "Charlie, get down on the floor. Okay, get back up."; and modeling each exercise prior to completion. Many of these strategies were integrated into the protocol (eg, modeling and giving 2 choices) while others were used as needed to overcome barriers by the participants (eg, targets on ground during lunges).

Over the first 2 weeks of the program, a 15RM (repetition maximum) was targeted to allow acclimation to exercises and act as a build-up process.[32,33] This intensity is representative of 50% of an individual's 1RM. Target intensity of strength exercises following this initial phase ranged from 8RM to 12RM, representing 60% to 80% of a 1RM; therefore, as more repetitions were completed, the exercise intensity was increased appropriately. Once the participant was able to complete more than 12 repetitions of a particular strengthening exercise, the intensity was increased either by addition of a weighted vest, weighted belt, or medicine ball, or increased by progression of activity (eg, progress to floor to stand tasks). For example, in Case 1, she began at the initial session with a body-weight forward lunge completing 15RM then, over time, was able to complete at 20RM in subsequent sessions; therefore, she held a medicine ball for completion of 15RM, which required continued progression to 10-pound weight vest. Once she was able to complete the appropriate repetitions, this was progressed to a body-weight walking lunge in the hallway. She eventually increased to completing the walking lunge with a 20-pound weight vest. Intensity of balance exercises was altered by variation of base of support or increased compliance of surface to continue to challenge the participant's postural stability. For example, lateral hopping was initiated on a firm surface, then progressed to a compliant surface once the participant did not report a challenge.

A representation of the exercise sessions for the 3 case studies is outlined in Table 4. All 3 cases demonstrated a progression of strength and balance activities throughout the sessions as indicated by either completing more challenging exercises (eg, lunge to walking lunge; progression to floor to stand exercises; addition of dual-task component) or increased difficulty of same exercise (eg, addition of medicine ball or weighted vest; progression from firm to compliant surface). All of these progressions were completed without significant concern of injury due to the systematic progression using the multiple RM method of measuring intensity in the strength exercises. It is noteworthy that cognitive status did not hinder participation in the moderate-intensity program since the program was developed with the needs of IWDs in mind. For example, Case 2 who had severe cognitive impairment (MMSE = 11) was able to successfully complete moderate-intensity strengthening and balance activities including weighted floor to stand exercises (with 15-pound weight vest), weighted sit to stand exercises (up to a 25-pound weight vest), plyometric jumping (with 14-pound weight belt), hopping, and tandem walking. This success was likely due to conceptual frameworks that guided the development and implementation of the exercise program. Specifically, the principles of exercise science that guided the incremental increases in dosage ensuring that participants met the minimum requirements to promote beneficial adaptations. In addition, the use of functional exercises was critical in the success of the program, which allowed participants to challenge the entire neuromuscular system relying on procedural memory, which aligns with tenets from the Strength-Based Approach.

These cases also highlight the importance of individualized and tailored programming in older adults. Continually reassessing intensity enabled researchers to ensure that a moderate intensity was achieved throughout the program in all cases. This was paramount to achieve significant change in performance as outlined by the principles of exercise science. For example, Case 1 (a 79-year-old, 62-inch, 46.2-kg female) initially progressed from a body-weight lunge at 15RM to a walking lunge using a 12.5-pound weight vest for 10RM at session 12. At the final session, Case 1 had progressed to a walking lunge with a 20-pound weight vest for 12RM. This dramatic example demonstrates that IWDs can actively engage and participate in a moderate-intensity exercise program in a meaningful and important way that improves functional abilities, which are vital to maintaining one's independence and overall physical health. Furthermore, the significant improvement in functional ability is important as previous research has directly tied strength, balance, and mobility to fall risk and institutional placement.[7,11,12] This example also highlights how researchers and clinicians can develop and implement programs for IWDs that are successful, and that researchers and clinicians cannot make assumptions of an individual's ability based solely on physical stature or cognitive ability.

Outcomes

All participants in this case series noted improvements in at least two physical performance assessments (Table 1) demonstrating that despite inter-individual differences in age, gender, height/weight, cognitive status, and health status, the standardized but flexible moderate-intensity exercise protocol was beneficial to these participants. Case 1 demonstrated a 0.5 m/s improvement in fast gait speed and an increase of 2 repetitions on the 30-s chair stand test, which are both clinically meaningful when compared with minimal detectable change (MDC) scores of 0.14 m/s for fast gait speed[34] and 2 repetitions for the chair stand test.[35] She scored at the maximum of 44 on the m-BBS at baseline; therefore, due to ceiling effects, there was no change documented. In addition, she noted a significant decline in performance on the TMT-B of almost 200% and had an increase in depressive symptoms of 8 points (from 2 to 10) on the 15-point scale, which prompted a referral to her primary care physician. These changes did not hinder her ability to complete all 24 sessions of the intervention.

Following completion of 24 sessions, Case 2 demonstrated an increase of 0.36 m/s in fast gait speed, which also exceed the MDC value of 0.14 m/s[34] along with a 5-point improvement on the m-BBS from 37 at baseline to 42 at completion. While no MDC is available for the m-BBS, a value ranging from 4 points to 6.5 points was found meaningful in the original Berg Balance Scale[36,37]; therefore, it is likely that a 5-point change in a shorten measure may be clinically relevant to aid in improvements in daily activities, such as walking, as well as potentially reduce his risk for falls. This participant had a 3-point decrease in depressive symptoms (from 4 to 1) on the 15-point scale over the 12-week period and was unable to complete the TMT-B at the follow-up assessment.

Finally, Case 3 demonstrated improvements in both comfortable and fast gait speeds of 0.08 and 1.0 m/s, respectively, following completion of the 24 sessions. These were both over the MDC values of 0.04 m/s for comfortable gait speed[38] and well above the MDC value of 0.14 m/s for fast gait speed.[34] In addition, he experienced an increase of 3 repetitions in his 30-s chair stand test, which is better than the MDC value of 2 repetitions.[35] As in Case 1, he experienced an increase in reported depressive symptoms over the 12-week period from 2 to 7 on the 15-point scale.

In addition to the quantitative acceptability and feasibility data of the larger study, anecdotally, the participants and

Table 4. Select intervention information.

	EXERCISE TYPE	INITIAL SESSION			MID-INTERVENTION			FINAL SESSION		
		EXERCISE	INTENSITY/ SURFACE	REPS/ TIME	EXERCISE	INTENSITY/ SURFACE	REPS/ TIME	EXERCISE	INTENSITY/SURFACE	REPS/ TIME
Case 1	Strength	Lunge	BW	15RM	Walking lunge	12.5# vest	10RM	Sit->stand	25# vest (couch)	17RM
			2# ball	25RM		12.5# vest	9RM		25# vest (couch)	9RM
		Jumping	BW	17RM	Side lunge	30# vest	20RM	Walking lunge	20# vest	12RM
			BW	20RM		30# vest and 5# ball	20RM		20# vest	20RM
	Balance	Heel/toe walking	Even	1 min	Heel/toe walking	Even	1 min	Heel/toe walk	Dual-task with ball toss	1 min
			Even	1 min		Even	1 min		20# vest	1 min
		Lateral hopping	Even	1 min	Lateral hopping	Compliant	1 min	Lateral hopping	Compliant	1 min
			Even	1 min		Compliant	1 min		Compliant	1 min
Case 2	Strength	Jumping	BW	25RM	Floor->stand	10# vest	17RM	Sit->stand	20# belt (couch)	11RM
			10# belt	15RM		15# vest	9RM		20# belt (couch)	6RM
		Step up (6″)	BW	15RM	Step up (12″)	BW	10RM	Jumping	14# belt	12RM
			BW	8RM		BW	9RM		14# belt	11RM
	Balance	Heel/toe walk	Even	1 min	Tandem walk	Even	1 min	Lateral hopping	Even	1 min
			Even	1 min		Even	1 min		Even	1 min
		Lateral hopping	Even	1 min	Dual-task ball toss	Even	1 min	Ball behind back	Even	1 min
			Even	30 s		Even	1 min		Even with 5# ball	1 min
Case 3	Strength	Lunge	BW	25RM	Step up (16″)	10# vest	20RM	Side lunge	30# vest	20RM
			20# vest	15RM		15# vest	20RM		30# vest and 5# ball	20RM
		Floor->stand	BW	16RM	Walking lunge	20# vest	14RM	Walking lunge	20# vest	11RM
			BW	16RM		20# vest	8RM		20# vest	11RM
	Balance	Dual-task ball toss	1# ball/even	1 min	Dual-task ball toss	1# ball/even	1 min	Heel/toe walking	Holding ball behind back	1 min
			1# ball/even	1 min		1# ball/tandem	1 min		20# vest	1 min
		Obstacles	Even	1 min	Obstacles	Even	1 min	Tandem walk	Dual-task with ball toss	1 min
			Even	1 min		Even	1 min			1 min

Abbreviation: BW, body weight; RM, repetition maximum.

caregivers highlighted in this case series enjoyed their time in the intervention. One caregiver stated the intervention gave her respite as her husband was highly engaged during each session and seemed satisfied for the remainder of the day; therefore, had less wandering-type behaviors. Another caregiver said she did not have to "hold on" to her husband as much when they were out in the community. He appeared more steady especially in parking lots and going up and down curbs.

Discussion

Individuals with dementia of varying age, cognitive status, and physical stature were all able to benefit from a moderate-intensity functional strength and balance program that presented with a standardized but tailored protocol to ensure adequate dosage of exercise but allowed individualization based on the inter-individual difference of each participant. This case series supports previous research that when dosed appropriately, moderate-intensity exercise can be beneficial in IWDs[4,42] and highlights the individual nature of implementation of such a protocol that is still rooted in principles of exercise science. This also demonstrates the continued utility of exercise as a critical intervention for the management of symptoms of dementia. Currently, no medication has proven neuroprotective benefits against dementia nor have the physiological benefits of moderate-intensity exercise been mimicked pharmacologically.[40,41] Moderate-intensity exercise is accessible to IWDs later into the disease process than many cognitive rehabilitation techniques as it relies heavily on cognitive domains, such as procedural memory, which remain intact late into the disease process.[27,42–44] This case series highlights the use of standard but flexible exercise protocol that was able to be tailored to individuals of differing cognitive and physical abilities. These findings demonstrate the pivotal part a physical therapist, known as experts in functional exercise, could play in maintaining the functional independence of IWDs regardless of the stage of their disease.

The outlined program consisted specifically of functional lower extremity strength and balance activities; therefore, these are the outcomes that should demonstrate a high level of improvement. These outcomes are key in the overall functional ability of older adults as they are key modifiable risk factors for falls, dependence, and potential institutionalization. Gait speed been described as a function of strength and balance;[45] therefore, improvements in fast gait speed are most likely due to the contributions of strength and balance gains. These results support previous literature highlighting exercise with IWDs resulting in improved functional performance.[4,36,46,47] While this strength and balance intervention intended also to have impacted cognition and psychosocial well-being, no effect was noted in these 3 cases. Previous studies have revealed that strengthening can improve cognition through changes in hormonal levels, specifically, insulin-like growth factor-1 and brain-derived neurotrophic factor; however, these findings also conclude that a combination of strength and aerobic training has more impact on cognition.[3,46,48] This and most other exercise programs are designed to differentially affect one or two outcome measures (eg, strength, balance, depression); however, it would be most impactful to affect multiple outcomes simultaneously. Therefore, it is possible that a more diverse multicomponent intervention might be needed to impact a large variety of outcomes, such as including an aerobic exercise component.

In addition, while these case studies were not a result of physical therapy interventions, specifically, research has found that participation in rehabilitation has mediated the relationship between cognitive impairment and rehabilitative outcomes.[13] Therefore, it is possible that using similar implementation strategies guided by the Strength-Based Approach may improve participation in rehabilitation services, which can potentially improve outcomes for IWDs following therapy. This is supported by a recent study outlining barriers and motivators to physical activity for IWDs stating in the early stages, patients and their caregivers focused on positive characteristics that are largely unaffected by the disease process,[49] which aligns well with the guiding principles of the intervention. These results highlight the need to implement evidence-based protocols that are grounded in research and science as well as using individualized and tailoring plans of care to ensure adequate dosing for each individual throughout an episode of care, which can help counteract the numerous barriers that were outlined by the physiotherapists.[49] Using principles from a theoretical basis such as the Strength-Based Approach can allow rehabilitation professionals to individualize their therapeutic intervention to the needs of each patient while still adhering to exercise science and rehabilitation principles. It places an emphasis on the individual's abilities that can improve engagement through the trajectory of the illness. This approach would not require a complete change in the clinician's approach to patient care, but rather an adjustment in thinking to better align with a patient needs.

Future directions of research

One of the benefits of case series research design is its ability to identify needs for future research. These 3 cases certainly contribute in that capacity with the potential for future studies. It would be beneficial to identify whether caregivers could be trained to assist in implementation or supervision of the exercise program to allow for a wider use of this type of program. Caregivers were available for all sessions and participated when needed for balance activities. Anecdotally, caregivers expressed enjoyment in being able to see their loved ones participate at such a high level in an exercise program and asked many questions about continuation of the activities following the intervention. An Otago-based home exercise program instructed caregivers to monitor a home walking program as well as correct performance of standing exercises[50]; therefore, it is feasible that with proper training and education, a caregiver could deliver the intervention with support from a rehabilitation or exercise specialist. This education and support could reduce any potential increases in caregiver burden that may arise from this additional activity while allowing the caregiving dyad to enjoy the potential benefits of maintaining this higher level of physical function.

As mentioned previously, modifications of the intervention may allow more impactful results across various domains. For example, the addition of an aerobic component may allow benefits to be seen in cognition or depression while the addition of cognitive rehabilitation strategies or caregiver education may allow for a more holistic intervention affecting psychosocial outcomes for both members of the dyad. More research is needed in these areas to determine these potential effects.

In closing, findings from this article address several important issues. First, individuals with varying levels of cognitive impairment were able to successfully complete a moderate-intensity exercise program and improved on key functional outcomes. The selected conceptual theories were extremely important in the development and implementation of the intervention protocol. Principles from exercise science ensured the correct dosage of the protocol was received and the Strength-Based Approach ensured the specialized needs of IWDs were addressed by capitalizing on remaining abilities (ie, procedural memory) and mitigating impaired abilities (ie, use of external memory aids and communication strategies). These promising findings highlight the importance of developing interventions that directly target the care needs of IWDs and including implementation strategies that facilitate active engagement and success across the illness continuum.

Author Contributions

ND and KJ conceived of the research idea, developed the research strategy, and data analysis plan. ND implemented the intervention and performed the data collection. ND performed the analysis with guidance from KJ. ND wrote the manuscript with input and revision from KJ.

Author's Note

Katherine Judge is also affiliated with Benjamin Rose Institute on Aging, Cleveland, OH. Findings from this article have been presented at the 2018 Conference for the American Psychological Association in San Francisco, CA.

Ethical Approval

The current study was approved by the Institutional Review Board at Cleveland State University (#30134-JUD-HS).

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REFERENCES

1. Prince M, Wimo A, Guerchet M, Ali G, Wu Y, Prina M. World Alzheimer Report 2015: the global impact of dementia: an analysis of prevalence, incidence, cost and trend. *Alzheimer's Disease International*, 2016. https://www.alz.co.uk/research/worldalzheimerreport2015summary.pdf
2. Thies W, Bleiler L. 2013 Alzheimer's disease facts and figures. *Alzheimers Dement*. 2013:9:208–245.
3. Kramer AF, Colcombe SJ, McAuley E, Scalf PE, Erickson KI. Fitness, aging and neurocognitive function. *Neurobiol Aging*. 2005;26:124–127.
4. Hauer K, Schwenk M, Zieschang T, Essig M, Becker C, Oster P. Physical training improves motor performance in people with dementia: a randomized controlled trial. *J Am Geriatr Soc*. 2012;60:8–15.
5. Thuné-Boyle I, Iliffe S, Cerga-Pashoja A, Lowery D, Warner J. The effect of exercise on behavioral and psychological symptoms of dementia: towards a research agenda. *Int Psychogeriatr*. 2012;24:1046–1057.
6. McGough EL, Logsdon RG, Kelly VE, Teri L. Functional mobility limitations and falls in assisted living residents with dementia: physical performance assessment and quantitative gait analysis. *J Geriatr Phys Ther*. 2013;36:78–86.
7. Suttanon P, Hill KD, Said CM, LoGiudice D, Lautenschlager NT, Dodd KJ. Balance and mobility dysfunction and falls risk in older people with mild to moderate Alzheimer disease. *Am J Phys Med Rehabil*. 2012;91:12–23. doi:10.1097/PHM.0b013e31823caeea.
8. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med*. 1998;319:1701–1707.
9. Munoz VM, van Kan GA, Cantet C, et al. Gait and balance impairments in Alzheimer disease patients. *Alzheimer Dis Assoc Disord*. 2010;24:79–84.
10. Verghese J, Robbins M, Holtzer R, et al. Gait dysfunction in mild cognitive impairment syndromes. *J Am Geriatr Soc*. 2008;56:1244–1251.
11. Camicioli R, Licis L. Motor impairment predicts falls in specialized Alzheimer care units. *Alzheimer Dis Assoc Disord*. 2004;18:214–218.
12. Kenny AM, Bellantonio S, Fortinsky RH, et al. Factors associated with skilled nursing facility transfers in dementia-specific assisted living. *Alzheimer Dis Assoc Disord*. 2008;22:255–260.
13. Lenze EJ, Munin MC, Dew MA, et al. Adverse effects of depression and cognitive impairment on rehabilitation participation and recovery from hip fracture. *Int J Geriatr Psychiatry*. 2004;19:472–478.
14. Mueller MJ, Maluf KS. Tissue adaptation to physical stress: a proposed "Physical Stress Theory" to guide physical therapist practice, education, and research. *Phys Ther*. 2002;82:383–403.
15. van Beveren PJ, Avers D. Exercise and physical activity for older adults. In: Guccione, AA, Avers, D, Wong, R, eds. *Geriatric Physical Therapy*, 3rd ed. St. Louis, MI: Elsevier Health Sciences; 2012:64–85.
16. Judge K, Yarry SJ, Orsulic-Jeras S. Acceptability and feasibility results of a strength-based skills training program for dementia caregiving dyads. *Gerontologist*. 2010; 50(3): 408–417.
17. Dawson N, Gerhart H, Judge K. Improved Functional Performance in Individuals with Dementia after a Moderate-Intensity Home-Based Exercise Program: A Randomized, Controlled Trial. *J Geriatr Phys Ther*. 2019;42(1):18–27. doi: 10.1519 / JPT.0000000000000128.
18. Dawson N, Judge K, Gerhart, H. Findings from a Strength-Based Moderate-Intensity Exercise Interventions for Individuals with Dementia (Innovative Practice). *Dementia*. 2017. doi: 10.1177/1471301217730951.
19. Orsulic-Jeras S, Shepherd JB, Britton PJ. Counseling older adults with HIV/AIDS: a strength-based model of treatment. *J Ment Health Counsel*. 2003;25: 233–244.
20. Bohannon RW. Population representative gait speed and its determinants. *J Geriatr Phys Ther*. 2008;31:49–52.
21. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol*. 1994;49: M85–M94.
22. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport*. 1999;70:113–119.
23. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Activ*. 1999;7:129–161.
24. Rikli RE, Jones CJ. *Senior Fitness Test Manual*. Champaign, IL: Human Kinetics; 2013.
25. Lach HW, Chang YP, Edwards D. Can older adults with dementia accurately report depression using brief forms? reliability and validity of the geriatric depression scale. *J Gerontol Nurs*. 2010;36:30–37.
26. Yesavage JA, Brink T, Rose TL, et al. Development and validation of a geriatric depression screening scale: a preliminary report. *J Psychiatr Res*. 1983;17:37–49.
27. Lezak MD. *Neuropsychological Assessment*. 4th ed. New York: Oxford University Press; 2004.

28. Reitan RM. Validity of the Trail Making Test as an indicator of organic brain damage. *Percept Motor Skill*. 1958;8:271–276.
29. Benjamin Rose Institute. *Cleveland Alzheimer's Managed Care Demonstration: Caregiver & Patient Interviews (T1). Assessment Tool, Margaret Blenkner Research Institute*. Cleveland, OH: Benjamin Rose Institute on Aging; 1998.
30. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. *JAMA*. 1963;185:914–919.
31. Lawton MP, Brody E. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9:179–186. doi:10.1093/geront/9.3_Part_1.179.
32. Littbrand H, Rosendahl E, Lindelöf N, Lundin-Olsson L, Gustafson Y, Nyberg L. A high-intensity functional weight-bearing exercise program for older people dependent in activities of daily living and living in residential care facilities: evaluation of the applicability with focus on cognitive function. *Phys Ther*. 2006;86:489–498.
33. Avers D, Brown M. White paper: strength training for the older adult. *J Geriatr Phys Ther*. 2009;32148–152, 158.
34. Goldberg A, Schepens S. Measurement error and minimum detectable change in 4-meter gait speed in older adults. *Aging Clin Exp Res*. 2011;23:406–412.
35. Hesseberg K, Bentzen H, Bergland A. Reliability of the senior fitness test in community-dwelling older people with cognitive impairment. *Physiother Res Int*. 2015;20:37–44.
36. Donoghue D, Stokes EK. How much change is true change? the minimum detectable change of the Berg Balance Scale in elderly people. *J Rehabil Med*. 2009;41:343–346.
37. Romero S, Bishop MD, Velozo CA, Light K. Minimum detectable change of the Berg Balance Scale and Dynamic Gait Index in older persons at risk for falling. *J Geriatr Phys Ther*. 2011;34:131–137.
38. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc*. 2006;54:743–749.
39. Rosendahl E, Lindelöf N, Littbrand H, et al. High-intensity functional exercise program and protein-enriched energy supplement for older persons dependent in activities of daily living: a randomised controlled trial. *Aust J Physiother*. 2006;52:105–113.
40. Ahlskog JE, Geda YE, Graff-Radford NR, Petersen RC. Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. *Mayo Clin Proc*. 2011;86:876–884.
41. Stranahan A, Zhou Y, Martin B, Maudsley S. Pharmacomimetics of exercise: novel approaches for hippocampally-targeted neuroprotective agents. *Curr Med Chem*. 2009;16:4668.
42. Beaunieux H, Eustache F, Busson P, De La Sayette V, Viader F, Desgranges B. Cognitive procedural learning in early Alzheimer's disease: impaired processes and compensatory mechanisms. *J Neuropsychol*. 2012;6:31–42.
43. Machado S, Cunha M, Minc D, et al. Alzheimer's disease and implicit memory. *Arq Neuropsiquiatr*. 2009;67:334–342.
44. Mahendra N, Scullion A, Hamerschlag C. Cognitive-linguistic interventions for persons with dementia: a practitioner's guide to 3 evidence-based techniques. *Top Geriatr Rehabil*. 2011;27:278–288. doi:10.1097/TGR.0b013e31821e5945.
45. Mantel AA, Chizmar S, Haffke L, Trapuzzano A, Dawson N. An Investigation of the predictors of comfortable and fast gait speed in community dwelling older adults. *J Geriatr Phys Ther*. In press.
46. Bossers WJ, van der Woude LH, Boersma F, Hortobágyi T, Scherder EJ, van Heuvelen MJ. A 9-week aerobic and strength training program improves cognitive and motor function in patients with dementia: a randomized, controlled trial. *Am J Geriatr Psychiatry*. 2015;23:1106–1116.
47. Perrochon A, Tchalla AE, Bonis J, Perucaud F, Mandigout S. Effects of a multicomponent exercise program on spatiotemporal gait parameters, risk of falling and physical activity in dementia patients. *Dement Geriatr Cogn*. 2015;5:350–360.
48. Kramer AF, Erickson KI, Colcombe SJ. Exercise, cognition, and the aging brain. *J Appl Physiol*. 2006;101:1237–1242.
49. Karssemeijer EG, Bossers W, Rikkert M. Ranking barriers, motivators, and facilitators to promote physical activity participation of persons with dementia: an explorative study [published online ahead of print August 7, 2018]. *J Geriatr Phys Ther*. doi:10.1519/JPT.0000000000000210.
50. Suttanon P, Hill KD, Said CM, et al. Feasibility, safety and preliminary evidence of the effectiveness of a home-based exercise programme for older people with Alzheimer's disease: a pilot randomized controlled trial. *Clin Rehabil*. 2013;27:427–438.