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Findings from a strength-based moderate-intensity exercise interventions for individuals with dementia (innovative practice)

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Abstract
Limited evidence exists regarding exercise interventions with individuals with dementia, which is often due to heterogeneity of methodology and outcomes being assessed. This led to the development and evaluation of a moderate-intensity home-based functional exercise program guided by theories from exercise science and the Strength-Based Approach. Data indicated excellent treatment adherence (99.04%) along with high levels of acceptability and feasibility in this sample (age 76.63 years (9.84); Mini Mental State Exam 18.87 (6.40)). This article informs future practice by highlighting the merits of a Strength-Based Approach in research examining exercise and physical rehabilitation to improve adherence and compliance with individuals with dementia.

Keywords
physical activity, Strength-Based Approach, non-pharmacological intervention

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Introduction

An estimated 35.6 million people (5–7% of the population) lived with dementia worldwide in 2010, with numbers expected to almost double every 20 years to 65.7 million in 2030 and 115.4 million in 2050 (Prince et al., 2013). Exercise and physical activity have been found to reduce the risk of chronic disease development as well as increase reserve capacity in older adults with a sedentary lifestyle (Chodzko-Zajko, Proctor, Singh, Salem, & Skinner, 2009). Regular participation in a long-term exercise program can improve balance and reduce the risk of falling in individuals with dementia; however, there is limited and mixed evidence in the current body of literature regarding the use of exercise with individuals with dementia (Dawson & Menne, 2017; Hauer et al., 2012; Littbrand et al., 2006; Netz, Axelrad, & Argov, 2007; Rolland et al., 2007). Examining the vast heterogeneity in methodology and outcomes measured across these studies, many of the interventions may not deliver an adequate level of intensity, frequency, or duration (dosage) to facilitate the necessary changes in performance (Dawson & Menne, 2017). Another potential reason for the mixed findings may stem from the fact that few interventions were designed with the needs of individuals with dementia in mind, resulting in challenges with fidelity during implementation.

To build on the successes of some of the previous literature as well as account for limitations, a moderate-intensity functionally based exercise program, adapted from the HIFE protocol (Littbrand et al., 2006), was developed using principles from exercise science, including the Physical Stress Theory (Mueller & Maluf, 2002) and the specificity principle (van Beveren & Avers, 2012) to ensure the adequate dosage of exercise. The development and implementation of the intervention were guided by tenets of a Strength-Based Approach (Judge, Yarry, & Orsulic-Jeras, 2010; Orsulic-Jeras, Shepherd, & Britton, 2003) to consider to the unique needs of individuals with dementia. This paper presents the results of the acceptability and feasibility of this novel and innovative moderate-intensity home-based functional exercise program for individuals with dementia and discusses implications for researchers and clinicians.

Description of the moderate-intensity exercise intervention protocol

The intervention was a home-based exercise program consisting of two main components (moderate-intensity functional strength and balance exercises), while including techniques that addressed the implementation needs of individuals with dementia. The functional strength and balance program were delivered two times per week lasting 12 weeks for a total of 24 sessions. Each of these practitioner-led sessions comprises four elements: (1) *Review*, which examined results from previous sessions and identified barriers to exercise completion reported by caregiver or individual with dementia; (2) *Education*, which outlined the purpose of the intervention and provided subsequent education to improve adherence; (3) *Planning* allowed the exercise practitioner to utilize implementation strategies, based on the Strength-Based Approach (Judge et al., 2010; Orsulic-Jeras et al., 2003), to overcome barriers reported by the individual with dementia or caregiver (Table 1); and (4) *Activity*, which delivered a tailored functional strength and balance program (Tables 2 and 3) based on the individual with dementia's functional status. Using functional activities provided increased familiarity relying on intact procedural and long-term memory per the Strength-Based Approach (e.g. chair stand, squat, tandem walking). The resulting protocol provided a significant amount of standardization and structure, while allowing flexibility to

Table 1. 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 e.g. "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 two possible activities
Using familiar activities or hobbies in exercise	Boredom; poor adherence; inability to complete activity properly	Procedural memory	

IWD: individual with dementia.

ensure individualized tailoring as needed for each session. A more detailed description of the components of the intervention can be found in the online supplementary material.

Initial starting exercises were determined based on performance during the baseline walking performance as developed by Littbrand et al. (2006) (Table 2). Within each of these categories, the practitioner and participant selected exercises (Table 3) based on their individual needs and preferences. The intensity of each session was self-paced; however, participants were regularly encouraged and coached by the practitioner to perform each exercise at the highest perceived level of exertion, while maintaining safety (Littbrand et al., 2006). The goal for each session was completion of two functional strengthening activities and two balance exercises. Target intensity of strength exercises following an initial two-week acclimation period ranged from 8 to 12 repetition maximum (RM (60–80% 1 RM)); therefore, as more repetitions could be completed, the exercise intensity was progressively increased as appropriate either by addition of a weighted vest, weighted belt or medicine ball, or increased by progression of activity (e.g. progress to floor to stand tasks). 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.

Table 2. 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 one 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 (Littbrand et al., 2006).

Table 3. Collection of exercises: Categories and examples.

Category	Description	Examples of exercises
A	Static and dynamic balance exercises in combination with lower-limb strength exercises	Forward/side lunge Step-ups Jumping
B	Dynamic balance exercises in walking	Stepping over obstacles Lateral hopping Heel/toe walking
C	Static and dynamic balance exercises in standing	Foot placement on target Stand with narrow base Tandem standing
D	Lower-limb strength exercises with continuous balance support	Sit to stand Squats Heel raises
E	Walking with continuous balance support	Forward walking Lateral walking

Acceptability and feasibility of the moderate-intensity exercise intervention

Sample recruitment

Participants were recruited from the Greater East Ohio Area Chapter of the Alzheimer's Association. *Inclusion criteria* consisted of: age 50 years or older, community-dwelling, able to walk household distances with or without an assistive device but without physical assistance (to allow for completion of necessary assessments), experiencing memory impairment affecting daily activities, and having a caregiver available to attend each exercise session as

Table 4. Participant characteristics and baseline physical performance.

	(*n=13*)	
Participant characteristic	Mean	*SD*
Age (range = 53–92 years)	73.78	8.50
MMSE (range = 9–28)	19.92	6.10
Chronic health conditions (range = 1–7)	4.15	1.95
GDS-short form (range = 0–16)	5.38	6.10
Exercise minutes per week (range = 0–350 minutes)	90.38	101.00
Self-rated health	2.31	0.75
TMT-B (time)	4:27	2:01
Gait speed (comfortable, m/s)	0.69	0.18
Gait speed (fast, m/s)	1.24	0.27
Chair stand test (reps)	14.0	5.82
m-BBS (max 44)	39.46	3.31
ADL scale (max 48)	7.25	6.43
	%	
Female	46.2	
College graduate	38.5	

ADL: activities of daily living; GDS: Geriatric Depression Scale; m-BBS: modified Berg Balance Scale; MMSE: Mini Mental State Exam; TMT-B: Trail Making Test – Part B. For Self-rated health, 0 = poor, 1 = fair, 2 = good, 3 = excellent. For m-BBS, higher score indicates better balance. 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.

well as assist during particular portions of the protocol that required a second person. *Exclusion criteria* consisted of: other neurological or myopathic conditions (i.e. Parkinson's disease, brain tumor, traumatic brain injury, muscular dystrophy, myositis ossificans) or scored less than 7 out of 30 on the Mini Mental State Exam (MMSE). The study was approved by the Institutional Review Board at Cleveland State University (#30134-JUD-HS). Written informed consent was obtained from both the individual with dementia and their caregiver.

Participant characteristics

Fifteen individuals with dementia were assigned to the intervention group (3 were assigned for pilot testing and 12 were randomly assigned). Of these 15 individuals with dementia, 13 completed the 12-week exercise intervention and were included in analyses. All of the participants (Table 4) in the current study were White and resided in the community with 78.3% being married with their spouse as their primary caregiver. The sample had an average age of 73.78 years ($SD = 8.50$), was 46.2% female, and exhibited mild to moderate level of cognitive impairment (MMSE: $\bar{X} = 19.92$; $SD = 6.10$).

Acceptability and feasibility findings

Acceptability and feasibility of the intervention was assessed via treatment adherence, tolerance to the intervention, and exercise-practitioner session evaluations.

Treatment adherence. Three hundred and nine of the scheduled 312 sessions were completed for a total treatment adherence of 99.04%. The three missed visits were by a single participant requiring medical intervention due to psychotic symptoms unrelated to the intervention. Once medication adjustments were made, the participant was able to resume the exercise intervention without difficulty and completed the remainder of the protocol.

Intervention tolerance. Intervention tolerance was examined by monitoring adverse events, which were defined as "discomfort that manifested itself or became worse because of the exercises" (Littbrand et al., 2006, p. 494) and categorized as either temporary and minor or serious and major. An adverse event was recorded if expressed by the participant (or caregiver) or changes in performance were noted by the practitioner.

Over the course of the current study, five minor adverse events (e.g. dizziness, back spasms, headache) and no major adverse events were noted during the 309 completed sessions (1.6%). All symptoms resolved allowing the participants to continue and complete the session. Additionally, 16 adverse events were noted between sessions with all being minor and temporary events (e.g. delayed onset muscle soreness, specific joint soreness) resolving before the subsequent session. Including both measures of adverse events, there was a total of 21 adverse events during the study, accounting for 6.7% of the total 312 available sessions.

Exercise-practitioner session evaluation. Following each exercise session, the exercise practitioner completed questions rating participant engagement, fidelity to the protocol, and the implementation process. Each question was rated on a four-point Likert scale (0 = not at all, 1 = some of the time, 2 = most of the time, 3 = for the entire session) examining both the exercise practitioner's perception of the participant's ability to engage and participate in the intervention (acceptability) as well as the exercise practitioner's level of confidence and efficiency in implementing the protocol (feasibility).

Results (Table 5) indicated participants were engaged throughout the intervention ($\bar{X} = 2.87$, $SD = 0.18$). Participants were able to understand ($\bar{X} = 2.89$, $SD = 0.19$) and complete ($\bar{X} = 2.87$, $SD = 0.19$) the protocol as delivered. Per the exercise-practitioner reports, participants were able to complete the exercises at the prescribed intensity ($\bar{X} = 2.97$, $SD = 0.07$) and did not appear frustrated ($\bar{X} = 0.02$, $SD = 0.05$).

The exercise practitioners felt confident in delivering the program efficiently ($\bar{X} = 2.99$, $SD = 0.12$) as well as addressing the questions and concerns of the participant and their caregiver ($\bar{X} = 3.00$, $SD = 0.01$). Adherence to the protocol was maintained ($\bar{X} = 2.86$, $SD = 0.24$) and a high level of enjoyment was reported by the practitioner ($\bar{X} = 2.93$, $SD = 0.11$). Overall, these results indicate excellent acceptability and feasibility as evaluated by the exercise practitioners.

Discussion

Individuals with dementia were able to effectively participate and engage in a program that implemented a progressive moderate-intensity exercise protocol. The intervention was well tolerated by participants and had an extremely high level of treatment adherence (99%). Compared to similar programs this percentage was found to be higher, which may reflect key aspects of the protocol, including implementation within individual's homes and using a Strength-Based Approach. For example, a study that implemented a strength and balance outpatient program demonstrated an 85% attendance rate over three months (Hauer et al., 2012). Similar studies

Table 5. Summary of exercise-practitioner session evaluation ($n = 13$).

	Overall (24 sessions)	
During this session, how much did the participant:	Mean	*SD*
Engage in the program	2.87	0.18
Understand the material and protocol	2.89	0.19
Complete the protocol without additional instruction using Physical cues or assistance	2.87	0.19
Perform at the prescribed intensity	2.97	0.07
Get frustrated by the protocol	0.02	0.05
During this session, how much did you (exercise practitioner):		
Feel that you adequately addressed the questions and concerns of the dyad	3.00	0.01
Adhere to the protocol	2.86	0.24
Enjoy leading the session	2.93	0.11
Feel confident in ability to deliver program effectively	2.99	0.12

For each item, 0 = not at all, 1 = some of the time, 2 = most of the time, 3 = for the entire session.

found adherence rates of 72% (Littbrand et al., 2006), 33.2% (Rolland et al., 2007), and 70% (Netz et al., 2007). Treatment adherence is an important component of acceptability as it measures participant's willingness to participate and engage. Treatment adherence also can impact program exposure or dosage of the intervention, which is related to the structure of the intervention (Fraser & Galinsky, 2010).

Additionally, key motivational factors were embedded in the protocol. Research has found that purposeful activity, accessibility, and meaningful program content were important motivators for older adults engaging in physical activity (Costello, Kafchinski, Vrazel, & Sullivan, 2011). The current intervention included functional strengthening exercises that mimic everyday activities and facilitate engagement. This type of exercise is more pragmatic for the needs of individuals with dementia as it relies on procedural memory, which remains relatively intact late in the disease (Beaunieux et al., 2012; Machado et al., 2009), rather than unfamiliar tasks that require new learning and is pragmatic for rehabilitation practitioners.

The rate of 6.7% adverse events (e.g. muscle soreness, joint pain) was taken as evidence of the acceptability of the intensity and progressive nature of the intervention (Littbrand et al., 2006). The current sample comprises relatively healthy, community-dwelling older adults with mild to moderate symptoms of dementia. Exercise professionals with specialized training in working with older adults closely supervised the exercises. Participants experienced minimal challenges with soreness or discomfort and did not exhibit any significant frustration. As rated by the exercise practitioners, participants demonstrated high levels of engagement and understanding of the exercises and protocol. The exercise practitioners endorsed high levels of confidence and enjoyment during intervention implementation. These high levels of acceptability and feasibility most likely contributed to the excellent treatment adherence and program fidelity.

Practice implications

Individuals with dementia pose unique challenges (e.g. difficulties with attention, judgment, memory, communication) to researchers and clinicians; however, using a Strength-Based

Approach, remaining skills and cognitive strengths can be utilized to facilitate and optimize participation and success allowing for adequate evaluation of the given intervention. Study findings highlight the promise of integrating these techniques into research and rehabilitative practice involving individuals with dementia. The successful implementation of the current intervention indicates that principles from exercise science and the Strength-Based Approach may be easily applied to improve compliance and adherence to physical activity, exercise, and physical rehabilitation. Research has found participation in rehabilitation mediated the relationship between cognitive impairment and rehabilitative outcomes (Lenze et al., 2004). The current study, while not specifically focused on rehabilitation services, had a high adherence level and session engagement. Subsequently, using similar implementation strategies may improve participation in intervention research and rehabilitation services, thereby improving outcomes for individuals with dementia.

Declaration of Conflicting Interests

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