EXAMINING THE EFFECTS OF A MODERATE-INTENSITY HOME-BASED FUNCTIONAL EXERCISE INTERVENTION ON COGNITION AND FUNCTION IN INDIVIDUALS WITH DEMENTIA

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DEDICATION

This is dedicated to the amazing group of people that I had the pleasure of working with during the completion of this study – the dyads. I truly appreciate each of you for allowing me to share in a small part of your journey. Every day, you inspire me with your courage, resilience, and positive outlook on the challenging road ahead. I promise to shine a light as brightly as I can and forge ahead as the best researcher, clinician, and educator I can be. One day, I hope that this area of research is no longer needed, as a cure for Alzheimer’s disease and other dementias will have been found. In the meantime, keep laughing and spreading your wisdom and experience for those of us that follow.
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ABSTRACT

Individuals with dementia (IWDs) can experience difficulties due to the neurodegenerative pathology across 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. Exercise could be an excellent adjunct or alternative to available 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 aims of the current study was to 1) develop a moderate-intensity home-based functional exercise program for IWDs adapted from the HIFE protocol (Littbrand et al., 2006); 2) evaluate the acceptability and feasibility of this intervention; and 3) to test the efficacy on multiple outcomes.

A randomized-controlled intervention trial with a two-group pre-test and post-test design was used to evaluate a home-based moderate-intensity functional exercise program for IWDs. The intervention, developed using principles from exercise science along with a Strength-Based Approach, consisted of 24 sessions (twice weekly for 12 weeks) of a moderate-intensity
strength and balance program that was delivered in the participant’s home by a trained exercise practitioner.

The sample consisted of 23 IWDs with mild to moderate cognitive impairment (intervention group: n=13, comparison group: n=10). Overall, data indicated a high level of acceptability and feasibility of the current intervention for both participants and the exercise practitioner with a 99.04% treatment adherence. Excellent fidelity to the protocol was demonstrated as well as good tolerance to the moderate-intensity program as determined by low occurrence of adverse events (6.7% of total sessions). Efficacy was examined using multiple linear regression. Group assignment significantly predicted performance in key outcome measures. IWDs in the intervention group demonstrated significant improvements in lower-extremity strength ($t=3.26$, $p=.004$), balance ($t=4.13$, $p=.001$), and fast gait speed ($t=2.61$, $p=.02$).

These findings indicate that IWDs are able to participate and benefit from a moderate-intensity functional strength and balance program. Clinical implications and future directions of research are thoroughly discussed further.
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CHAPTER I
INTRODUCTION

Exercise and physical activity have been found to increase average life expectancy in humans through reduction of chronic disease development and other secondary aging effects (Chodzko-Zajko, Proctor, Singh, Salem, & Skinner, 2009). For example, for older adults who have a higher level of fitness, the risk for cardiovascular disease-related mortality is significantly reduced. It also is noted that predictors of premature mortality, such as muscular strength and power are beneficially affected by exercise. Exercise also can increase reserve capacity in older adults with a sedentary lifestyle thereby affecting the secondary aging process as well as increase aerobic capacity and muscle strength (Chodzko-Zajko et al., 2009). In addition to these improvements, physical activity and exercise can differentially affect multiple domains including cognition (Kramer, Colcombe, McAuley, Scalf, & Erickson, 2005), functional status
including falls (Hauer et al., 2012) as well as various aspects of psychological well-being (Thuné-Boyle, Iliffe, Cerga-Pashoja, Lowery, & Warner, 2012).

With many of these positive findings having been identified in healthy older adults, it can be questioned as to whether these effects would be in a clinical population, such as diabetes, cardiac patients, or even those with dementia. Research questions have arisen to determine whether exercise can be used as an efficacious intervention to assist individuals with dementia (IWDs) in slowing the secondary ramifications associated with the pathology, such as declines in strength, balance, functional mobility, or difficulties with activities of daily living. Exercise would be an excellent adjunct or alternative to currently available interventions as it is a non-pharmacological, inexpensive, and accessible approach to potentially modifying the impact of the illness on IWDs (Nagamatsu et al., 2014). Intervention research with IWDs is vital as individual and societal ramifications of the pathology is becoming more salient for older adults and their families (Douglas, James, & Ballard, 2004; Nagamatsu et al., 2014). This line of research helps better understand how various factors, such as psychological, behavioral, and physical factors, may contribute to the health and wellness of these individuals.

It was estimated that 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). IWDs experience a variety of difficulties because of this pathology including cognitive decline and functional deficits, such as decreased strength, balance,
and functional mobility. Most types of dementia 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 $604 billion in 2010 (Wimo, Jönsson, Bond, Prince, & Winblad, 2013). By the age of 80 years, 75% of individuals with Alzheimer’s disease, which is the most common type of dementia, will require placement in a long-term care facility as opposed to 4% of the general population (Thies & Bleiler, 2013). Since walking speed and balance are among predictors significantly associated with transfers to long-term placement (Kenny et al., 2008), interventions aimed at improving these outcomes may assist IWDs and their families in delaying the need for long-term care.

IWDs are at a higher risk for mobility difficulties including impairments of balance and gait (Eggermont et al., 2010; Munoz et al., 2010; Suttanon et al., 2012; Verghese et al., 2008). Munoz et al. (2010) found that 25% of their sample of 380 patients with Alzheimer’s disease exhibited balance deficits while 20% presented with gait impairments. Patients with dementia also are at a significantly higher risk of falls (Asada et al., 1996; Rubenstein, 2006; Rubenstein, Josephson, & Robbins, 1994; Tinetti, Speechley, & Ginter, 1988). While the exact cause of this increased risk is not understood, gait variability and declines in executive function have been posited as being important factors (Asada et al., 1996; Camicioli & Licis, 2004; Suttanon et al., 2012). Interventions targeting these individual outcomes may delay or prevent many of these resulting adverse effects.
Currently, the body of literature consists of interventions attempting to alter the effects of the dementia pathology on several of these mentioned outcomes including different functional limitations that may result in disability. However, the literature contains mixed evidence and conflicting results. Gathering a better understanding of these findings may allow researchers and clinicians to develop more efficacious interventions that can provide consistent results for these individuals. When reviewing any intervention, a cursory understanding of the intervention development and research process is helpful as it can assist the reader in interpreting the results and determining the necessary next steps.

**Intervention Development and Research**

While several frameworks have been used to describe the intervention research process (e.g., the 5-phase model), most have common themes to guide researchers through the important process of intervention development and implementation as well as study design to allow for proper evaluation of the intervention (Fraser & Galinsky, 2010; Greenwald & Cullen, 1985; Sussman, Valente, Rohrbach, Skara, & Pentz, 2006). It is important for researchers to inform the reader that the appropriate steps have been taken during the development, implementation, and evaluation of any intervention. This allows the reader to critically assess the level of rigor used during the process, which is integral in determining whether the results and implications are appropriate and acceptable.

In the early phases of intervention research, theoretical considerations should be identified and highlighted to assist with the design of the intervention
components as well as the design of the evaluation study. Theories give a better understanding to how processes interact with one another to produce outcomes within a given timeframe and context (Morgan-Trimmer, 2013). Leeuw and Vaessen (2009, p. 16) state, "intervention theory provides an overall framework for making sense of potential processes of change induced by an intervention" (p. 16).

For example, exercise science theory can inform the development, implementation, and evaluation of an exercise intervention. For exercise interventions, critical components of the intervention development revolve predominantly around the concept of dosage. Any intervention must be delivered at the appropriate level of intensity, duration, and frequency to ensure that intended changes are induced. The implementation of any intervention must ensure fidelity to the developed protocol. Finally, during the evaluation of any intervention, attention must be given to the link between intervention and outcomes (Leeuw & Vaessen, 2009).

Before outlining the current study, a brief review of cognition and function as related to dementia is warranted. Additionally, a summary of the current literature on the effects of exercise on each of these domains is important to understand how and why this current study was designed. Following this review, a discussion of the limitations of the literature will be presented along with the theories and principles used to guide the development, implementation, and evaluation of the current project.
Current Literature on Cognition and Functional Performance

**Cognition.** Dementia due to neurodegenerative disorders, such as Alzheimer’s disease, vascular dementia, or frontotemporal dementia, is characterized by changes in multiple cognitive processes. Hallmarks of these pathologies include loss of short-term and working memory, difficulty with executive function, and disorientation. Even though these individual areas may decline, compensatory strategies may be employed to bypass these affected systems to allow continued functional independence for these individuals (Bourgeois et al., 2003; Hopper et al., 2005). For example, use of simple external memory aids such as labels, scripts, or written home exercise programs, can allow an individual with dementia to compensate for difficulties with their memory to allow them to remain involved in daily household activities in addition to maintaining a level of exercise capacity (Bourgeois et al., 2003).

One specific cognitive process that has demonstrated potential to be amenable to intervention in the current body of literature is *executive function* (Baker et al., 2010; Kemoun et al., 2010; Kramer et al., 2005; Kramer, Erickson, & Colcombe, 2006). This is an exciting proposition since executive function plays a crucial role in cognitive and functional performance. The importance of executive function, its link to functional performance, and current literature regarding the effects of exercise on this process is discussed further.

Executive function is classified as a higher-order cognitive domain, which integrates basic processes such as memory, attention, and perception. Lezak (2004, p. 35) states that executive functions “consist of those capacities that
enable a person to engage successfully in independent, purposive, self-serving behavior”. Difficulties with reasoning, judgment, and decision-making are the most common products of executive dysfunction in individuals with dementia. These changes in executive function are partially responsible for initial declines in functional status due to the complex nature of the relationship between cognition and function (as outlined in detail below), which can be seen initially with more complex tasks or instrumental activities of daily living (IADLs), and later progress to simpler daily tasks (Marshall et al., 2011). Even in the presence of declines in more basic cognitive processes, individuals with good executive function have the ability to remain independent, self-serving, and productive (Lezak, 2004). Therefore, identifying programs that could intervene on executive function may have significant benefits for individuals with dementia and potentially assist in maintaining higher levels of functional independence and reducing dependence on others.

With respect to the benefits of physical activity and exercise on cognition, some studies have found a connection between exercise and cognition in both healthy older adults and some samples of IWDs; however there is mixed evidence as other studies have found no effect of exercise on cognition in these healthy and clinical populations of older adults. Moderate levels of physical activity and exercise can have beneficial effects on several cognitive processes into middle- and old age in relatively healthy older adults (Kramer et al., 2005). Cardiovascular exercise, fitness levels, and higher levels of physical activity have been found not only to reduce risk of cognitive decline in healthy older adults, but
also to reduce the rate of progression in individuals with dementia (Chodzko-Zajko et al., 2009; Kramer et al., 2005; Kramer et al., 2006). Ahlskog, Geda, Graff-Radford, and Petersen (2011) note that no pharmacological intervention has been identified to reduce the risk of dementia or age-related cognitive impairment while exercise has been found to have neuroprotective benefits and potentiate resilience to these neurodegenerative diseases (Ahlskog et al., 2011). Other researchers have found aerobic training, resistance training, and especially combined programs to improve cognitive performance in both healthy and cognitively impaired older adults on some measures of cognitive function, especially those measuring executive function such as the Trail Making Test (Baker et al., 2010; Kemoun et al., 2010; Kramer et al., 2005).

Multiple mechanisms have been identified linking exercises to improvements in cognition, specifically executive function in healthy older adults and have been discussed or hypothesized in IWDs. Cardiovascular changes in the brain in response to aerobic training include activation of the vascular nitric oxide (NO)/endothelial NO synthase pathway, upregulation of antioxidant enzymes as well as angiogenesis. These biologic adaptations can improve cerebral blood flow thereby potentially affect cognitive performance and cognitive reserve levels in individuals with Alzheimer’s disease (Lange-Asschenfeldt & Kojda, 2008). Additionally, exercise, specifically strength training, can impact levels of insulin-like growth factor 1 (IGF-1), which has neuroprotective effects. Brain-derived neurotrophin factor (BDNF) also is up-regulated with aerobic training, which has been found to be important in synaptogenesis and
neurogenesis (Kramer et al., 2005). Operationally, aerobic exercise is defined to include sustained (20-30 minutes) activity sufficient to increase the heart rate to at least 60% of its maximum capacity (Ahlskog et al., 2011).

The effectiveness of a high-intensity aerobic training program on cognition was tested on older adults with mild cognitive impairment (Baker et al., 2010). The intervention included four days per week of 45-60 minutes of aerobic exercise at 75-85% of the participant’s heart rate reserve over six months. Significant improvements were identified in measures of executive function, including the Trail Making Test – Part B (Baker et al., 2010). Improvements in executive function may be potentially beneficial in domains of functional status including activities of daily living and gait due to the close link between cognition and function.

Additionally, Kemoun et al. (2010) completed a study comparing the effects of aerobic activity at a level of 60-70% of heart rate reserve (three days per week for 60 minutes per session over 15 weeks) to that of usual care in cognition on a sample of 38 nursing home residents. Participants in the exercise group improved significantly in the Rapid Evaluation of Cognitive Function, which includes 12-subtests such as attention span, reasoning and judgment, apraxia, visual decoding, and writing indicating that exercise at an appropriate level can affect multiple domains of cognition including executive function (Kemoun et al., 2010).

On the other hand, a study by Eggermont, Swaab, Hol, and Scherder (2009) reported that a walking program conducted five days per week for 30
minutes per session over a span of six weeks did not result in any significant changes in multiple cognitive domains including face recognition, picture recognition, and memory tasks. It is possible that the intensity or duration of the program was not sufficient to induce the necessary changes in the program (level of intensity was not discussed in the procedure). For example, if the level of intensity did not reach the intensity mentioned by Ahlskog et al. (2011), it is likely that the dosage of the intervention would not reach a therapeutic level needed to induce the biological adaptations needed to demonstrate a change in cognitive performance. This differs from the studies conducted by Baker et al. (2010) and Kemoun et al. (2010) which both highlighted levels of intensity necessary to elicit those beneficial effects.

More research is needed to determine the relationship between exercise and cognition, specifically executive function. Emphasis on dosage is needed to ensure that therapeutic levels of exercise are obtained. Executive function plays a vital role in maintaining functional independence for older adults due to the complex nature of many of our daily tasks.

**Functional Performance.** Function can be conceptualized on many different levels. Generally, functional capacity can be defined as “the maximum output or ability of a person to perform natural and expected activities within the framework of environmental circumstances” (Ernst & Ernst, 1982, p. 10). The “natural and expected activities” are complex tasks that are traditionally understood by most to consist of various activities of daily living (ADLs). It is important to understand that simpler motoric function, such as balance and
strength, are an integral component of these higher level tasks. Both levels of functional status must be studied and examined as the more basic functional components of strength and balance can certainly compromise the more complex functional tasks of ADLs. In the current study, both the simpler components and more complex tasks are considered important in understanding the overall functional performance of the individual. The terms function and functional are used to describe performance in these different level of activities throughout the current study.

As mentioned earlier, difficulties with function can be described in a hierarchical manner being closely related to cognitive declines with more complex tasks being the most difficult due to higher levels of cognition needed (Marshall et al., 2011; Njegovan, Man-Son-Hing, Mitchell, & Molnar, 2001). Individuals with dementia will initially note difficulty in this area mostly with higher level instrumental activities of daily living (IADLs) that require executive function and effortful assemblage of resources for successful completion (Marshall et al., 2011). Examples include financial or medication management, driving outside of familiar environments, or shopping. Individuals with dementia may not experience difficulty with more basic activities of daily living, such as dressing, bathing, and toileting, (ADLs) until later in the disease because of their repetitive and automatic nature. Cognitive resources are not recruited to the same level in these automatic tasks as in more complex or unfamiliar tasks; therefore, IWDs can continue to be involved in many aspects of self-care if able to maintain appropriate levels of strength, balance, and endurance.
Individuals with dementia have a higher rate of functional mobility problems and falls (McGough, Logsdon, Kelly, & Teri, 2013; Suttanon et al., 2012; Tinetti et al., 1988). These mobility problems are usually related to functional limitations such as gait and balance, which can be common in older adults with cognitive impairment (McGough et al., 2013; Munoz et al., 2010; Suttanon et al., 2012; Verghese et al., 2008). Significant differences have been identified in standardized assessments of gait, such as the four-meter walk test when comparing cognitively impaired individuals to healthy older adults (Eggermont et al., 2010).

These deficits in functional mobility, balance, and gait can be partially responsible for declines in functional performance, institutionalization, or even the increased risk of falls in this population (Camicioli & Licis, 2004; Kenny et al., 2008; Suttanon et al., 2012). Identifying strategies to combat these declines is crucial in maximizing a person’s independence in hopes to allow 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 (Camicioli & Licis, 2004) while walking speed has been found to be associated with transfer from assisted living residence to a skilled nursing facility (Kenny et al., 2008); therefore, it is possible that improvements in walking speed through exercise could allow an IWD to “age in place” longer, which is an important goal for applied gerontologists (Sterns & Camp, 1998).
Just as the ability to successfully perform activities of daily living have been linked to executive function, emerging research has highlighted the relationship between gait stability and variability with executive function (IJmker & Lamoth, 2012; McGough et al., 2011). In one study, moderate to high correlations were identified between multiple gait parameters (e.g., cadence, step width, step length) and executive function indicating that decreased executive function plays an important role in increasing gait variability in individuals with dementia (IJmker & Lamoth, 2012). If a single intervention involving exercise could impact both executive function and gait, it would be instrumental for this patient population as exercise provides a safe modality that could be easily modified to suit individuals throughout the disease process.

Unfortunately, inconsistent findings of improved versus unchanged functional performance are prevalent in the research with individuals with dementia. Exercise has positive effects on aspects functional performance including strength and balance (Hauer et al., 2012; Heyn, Abreu, & Ottenbacher, 2004); however this relationship does not appear to be linear or well understood (Chodzko-Zajko et al., 2009). Functional activities, such as walking, stair climbing, and performance in activities of daily living are multi-dimensional, complex tasks that integrate multiple levels of physical and cognitive attributes. While an exercise intervention may improve a single dimension of functional performance or impairment such as strength or balance, it is unclear how those changes may impact functional performance in a higher-level functional task, such as ADL performance. In an effort to understand these inconsistencies, one
must critically assess the exercise intervention design and implementation as well as the research methodology.

On the positive side, older adults with cognitive impairment have been shown to improve with respect to functional outcomes (gait, balance, and transfers as the most common) following exercise interventions (Hageman & Thomas, 2002; Hauer et al., 2012; Kemoun et al., 2010; Rolland et al., 2007; Rosendahl et al., 2006; Santana-Sosa, Barriopedro, López-Mojares, Pérez, & Lucia, 2008). Kemoun et al. (2010) intervened upon a residential sample of cognitively impaired older adults using a tailored exercise intervention comprised of components of walking, equilibrium (balance), and stamina (aerobic endurance). The aerobic activity was completed on an ergocycle designed to monitor the participant’s heart rate to ensure a level of 60-70% of maximum heart rate. Walking and balance activities included walking over boards and zigzagging as well as dance and stepping activities. Findings revealed improvements in the intervention group on measures of gait and balance including improved walking speed and stride length as well as decreased double limb support (Kemoun et al., 2010).

Throughout the study, researchers carefully monitored the intensity and dosage of intervention being delivered by using equipment (ergocycle) to continuously monitor heart rate. Additionally, the researchers clearly outlined previous research connecting exercise to improvements in gait and balance. This explicit information allows the reader to understand the underlying mechanisms behind the intended affect of the intervention on outcomes.
Additionally, improvements in walking speed were noted in groups of individuals with moderate dementia having a history of falls (Toulotte, Fabre, Dangremont, Lensel, & Thévenon, 2003). In small groups, the participants undertook exercise to develop muscular strength, proprioception, static and dynamic balance, and flexibility. Theraband resistance was used in most exercises in addition to challenging balance by walking on a variety of uneven surfaces to perturb the center of gravity. In addition to walking speed, improvements were noted in balance and flexibility (Toulotte et al., 2003). Authors appeared to provide challenges to the participants (e.g., resistance bands to increase resistance and uneven surfaces to challenge balance), which potentially resulted in positive changes in balance in this sample of IWDs.

A high-intensity functional exercise program (HIFE) was developed and tested for feasibility and efficacy using a sample of mild to moderately impaired participants who required assistance for completion of ADLs and lived in a residential care facility (Littbrand et al., 2006; Rosendahl et al., 2006). The intervention included 45-minutes sessions completed five days over a two-week period for 13 weeks (total of 29 sessions). Participants were placed in groups of three to seven subjects with two supervising Physical Therapists as instructors. Selection of exercises was completed out of five potential categories (static & dynamic balance exercises in combination with lower-limb strength exercises, dynamic balance exercises in walking, static and dynamic balance exercises in standing, lower-limb strength exercises with continuous balance support, walking with continuous balance support) depending on participant’s initial ambulation
score. The intensity of exercises was self-paced, although encouragement was provided by the therapist to exercise at high intensity or increased difficulty. Goals for each session included completion of two lower-extremity strength and two balance exercises with two sets each session at a high level of intensity (Littbrand et al., 2006). As with previous studies, the authors did not explicitly outline the use of a theoretical framework although they did state that high-intensity exercise programs are widely used in healthy adults but not with IWDs. It appears as though this intervention again provided a level of difficulty that would be considered a moderate- to high-intensity program.

These authors examined the acceptability of the exercise intervention as well as feasibility and fidelity through reports of treatment adherence along with levels of intensity demonstrated by the participants during the exercise sessions. Authors report a high level of treatment adherence (median of 76%) with good tolerance to the intervention. Tolerance to the intervention was examined by recording any adverse events (e.g., injury, pain, cardiac event) that occurred during the exercise sessions. Participants were able to complete a median of 92% of the strength exercises and 96% of the balance exercises at a medium or high intensity level indicating the persons with mild to moderate dementia can participate in more challenging exercise interventions (Littbrand et al., 2006). Results also revealed that participants improved significantly in self-paced (comfortable) gait speed after three months of training while after six months, significant improvements were made on balance testing, chair-stand test, strength measures, and self-paced gait speed (Rosendahl et al., 2006). As
mentioned earlier, changes in gait and strength could have potential implications on other domains of function such as ADLs and falls. More research with similar methodologies is needed to strengthen and corroborate these results.

Additionally, Roach, Tappen, Kirk-Sanchez, Williams, and Loewenstein (2011) divided 82 long-term care residents into three groups: activity specific group, walking program group, and a social conversation group in attempts to improve functional mobility tasks. The activity specific exercise group completed a range of progressive strength, balance, and endurance activities including hip bends and toe raises, sidestepping, and supervised walking; while the supervised walking group performed only supervised walking. Researchers noted improvements in functional performance as measured through transfer scores on the Acute Care Index (Roach et al., 2011). Once again, while this study did not explicitly identify the use of guiding principles for the development of the intervention, apparent use of progressively challenging exercises led to positive outcomes in functional performance measures in a sample of IWDs. Additionally, the authors were careful to properly align the selected outcomes measures with components of the intervention. For example, testing for changes in transfer scores when one of the intervention groups focused on activity specific tasks designed to improve higher-level functional activities such as transfers. Therefore, it is not surprising that the activity specific group was the only group to demonstrate significant changes in functional domains as the other intervention group completed only walking tasks, which are not designed to affect transfers.
Finally, Hauer et al. (2012) tested a progressive resistance and functional training program with older adults with mild cognitive impairment in a geriatric outpatient setting. Exercise equipment was used to facilitate completion of strength training at 70-80% of the participant’s maximal performance for one repetition (1RM) in small groups of four to six participants over a three-month period. In addition, participants were trained to perform basic activity of daily task-related motor function such as walking, climbing stairs, and dancing. Participants in the intervention group improved significantly on strength and functional outcomes including gait and sit to stand performance as well as on levels of physical activity (Hauer et al., 2012). Interestingly, authors found that individuals with a poorer motor performance at the onset of the intervention made significantly greater gains with the program (Hauer et al., 2012). Use of familiar and functional tasks was successful in this study when used in adjunct with a more traditional strengthening program. As in the above studies, participants appeared to be challenged adequately and results were significant in important outcomes such as gait, participation in general physical activity, and strength.

Despite the research identifying positive functional outcomes as a result of exercise and physical activity, other researchers found no significant improvements (Burgener, Yang, Gilbert, & Marsh-Yant, 2008; Cott, Dawson, Sidani, & Wells, 2002; Netz, Axelrad, & Argov, 2007). Contrary to the studies finding efficacy in functional outcomes measures, many of following studies may not have delivered the adequate level of dosage for positive outcomes nor did they provide appropriate rationale for use of particular assessment tools. In
many cases, there seems to be a misalignment between selected outcomes and implemented intervention components. This can be compared to a pharmacological intervention in two ways.

First, if an anti-depressant has been found to require dosages of 150 milligrams to significantly reduce depressive symptoms, one should not be surprised if an individual taking only 50 milligrams does not have a beneficial experience using the medication. Additionally, if a medication has been found to significantly reduce anxiety, one should not be surprised that beneficial effects of the medications are not found when the clinician asks about pain levels. Just as with drug therapies, it is imperative that non-pharmacological interventions, such as exercise, are delivered at the necessary dosage found by previous research to result in beneficial outcomes. Additionally, researchers and clinicians must be measuring the appropriate outcomes that are amenable and aligned to the mode of activity being implemented based on previous research.

A home-based intervention (Reducing Disability in Alzheimer’s Disease: RDAD) including exercise was tested on individuals with mild to moderate dementia over a year period (Teri et al., 2003). RDAD also incorporated some behavioral and education techniques specific to dementia that intended to identify and modify individual behavioral problems impairing day-to-day function and adversely affect dyad interaction (Teri et al., 2003). Participants completed two supervised sessions per week during the first three weeks, and then weekly over the next four weeks followed by biweekly sessions over an additional four weeks. Finally, three follow-up sessions were conducted over the next three
months. RDAD was developed “to increase flexibility, endurance, and strength with the goal of decreasing the behavioral and physical disability common among persons with dementia” (Teri et al., 2012, p. 454) through 30 minutes per day of moderate-intensity exercise. Additionally, RDAD was designed to potentially “reduce functional dependence and delay institutionalization among patients with Alzheimer’s disease” (Teri et al., 2003, p. 2016).

Following the 12-week intervention, no significant changes were noted in walking speed or balance measures (Teri et al., 2003). It is interesting to note, that the authors did not measure outcomes related to strength, flexibility, or aerobic endurance, which were key components of the exercise intervention. It is possible that changes were noted in these domains but not noticed because of a misalignment between intervention and outcomes.

While the components of the intervention were intended to achieve a goal of moderate-intensity exercise, the intervention protocol described in the study does not identify any use of resistance or progression during the program, as “participants were taught exercises initially without weights to a maximum of 1 set of 12 repetitions” (Teri et al., 1998, p. 414), which raises question of sufficient intensity or dosage. There was no measure of intensity to monitor fidelity to the intended protocol. Participants and caregivers were responsible for completion of the instructed frequency after initial three weeks, which was not closely monitored by the intervention specialist. Therefore, it also is possible that frequency and duration were not adequate to elicit gains due to lack of protocol adherence. It is important to monitor intensity, frequency, and duration as in the
studies by Baker et al. (2010), Hauer et al. (2012), and Rosendahl et al. (2006) to ensure that an adequate dosage is being delivered to elicit hypothesized effects in various outcomes.

Cott et al. (2002) developed a walking intervention in efforts to improve walking distance as well as functional status in a group of severely impaired long-term care residents. No significant improvements were identified in functional status or walking distance when compared to the control group (Cott et al., 2002). The level of ambulation is this intervention was described as “self-paced” leading to concerns regarding level of intensity. With no discussion of rationale and use of guiding principles regarding intensity, duration, or choice in outcomes measures, it is difficult to truly identify intentional development and implementation of the stated exercise intervention. Readers are left unsure as to the reasons behind particular components of the intervention as well as to the alignment of outcomes measures.

Once again, researchers and clinicians must be thoughtful regarding the development of intervention strategies and ensure such strategies are guided by previous research with respect to the intervention development and implementation, as well as design of the efficacy and effectiveness studies. Some of these non-significant or negative outcomes may be misleading, as any interventions (pharmacological or non-pharmacological) needs to be delivered at a particular dose to be effective. If an intervention protocol is delivered incorrectly and found to be ineffective, then it is difficult to disentangle protocol design errors from true effects of the intervention.
The conclusion from these conflicting findings warrants further research to evaluate the efficacy of exercise on the domains of cognition and functional performance in IWDs. This research must be guided by theory and utilize appropriate alignment between the intervention and outcome measures in efforts to progress the literature in this important area of study.

**Limitations of Current Research on Exercise Interventions with IWDs**

It is clear that the evidence from these interventions is inconclusive, with some demonstrating positive and efficacious results of exercise in the domains of cognition and functional performance. There is a large amount of heterogeneity in the methodologies as can be seen in discussions above regarding previous intervention studies. These differences in both intervention components (e.g., mode of exercise, intensity of exercise, setting), outcome measures (e.g., walking speed, transfers, cognition), and research design limits the ability to aggregate or compare studies; however, there is one single predominant limitation that can be identified in most of these studies that needs addressed in order to strengthen the literature regarding the potential benefits of exercise for IWDs. There is a clear lack of guidance from a theoretical framework for research and intervention development. This single limitation has three separate ramifications that can be discussed further: 1) interventions may not deliver adequate intensity, frequency, and/or duration (dosage) to facilitate necessary changes in outcome measures, 2) misalignment of intervention components and outcome measures, and 3) few interventions were designed with needs of IWDs in mind.
First and foremost, through a review of the current exercise interventions for IWDs, it is possible that many of the interventions may not deliver adequate levels of intensity to facilitate necessary changes to improve outcomes of strength, balance, or functional capacity. For example, Roach et al. (2011) designed an intervention including a walking program aimed to improve endurance as measured by the 6-minute walk test. The number of minutes that the participants walked was progressively increased over the duration of the 16-week intervention; however there is not discussion of monitoring of intensity in which the individuals walked. The ACSM states that aerobic training must be completed at a moderate-intensity (e.g., 50-70% of maximum heart rate) to have a beneficial impact on aerobic capacity (American College of Sports Medicine, 2013). Many of the reviewed exercise interventions do not introduce discussion or state rationale for the levels of intensity, frequency, or duration used in the intervention. If the dosage of these interventions does not reach the necessary stress threshold, this could potentially be a reason for some of the non-significant findings rather than concluding exercise is not efficacious for IWDs.

The second ramification from the lack of guiding principles in the current research is use of outcome measures that do not align with intervention components. This issue may severely impact the validity of intervention evaluation. For example, having balance or strength outcomes solely for an intervention with a dedicated walking protocol may not be appropriate. If there is not a part of the intervention dedicated to improve strength or balance, it should not surprising that these outcomes do not demonstrate a significant
improvement. Non-significant findings could potentially result from poor selection of outcome measures instead of the effects of the intervention as previously discussed regarding the RDAD intervention. Researchers must provide rationale for selected outcomes by aligning selected assessment tools with components of the intervention. This explicit discussion will allow readers to better understand the potential effects of the intervention on the outcomes.

Finally, very few interventions identified components or modifications of the exercise program that were designed specifically for IWDs. Many claimed to use “simple exercises” to ease completion; however, use of over-simplified exercises or exercises at too low an intensity may nullify that impact of any intervention due to lack of necessary intensity or dosage. It is important to maintain fidelity to the intensity and dosage of the intervention while understanding some modifications need to be made for this specialized population with respects to intervention implementation. For example, the use of functional exercises has been recommended for older adults because of the familiarity and task-related training (vanBeveren & Avers, 2012). It is possible that this concept may translate nicely to IWDs as procedural memory remains relatively intact throughout the late stages of the illness. Interventions that have used this approach have demonstrated a high level of adherence in addition to successful outcomes (Hauer et al., 2012; Littbrand et al., 2006; Rosendahl et al., 2006). Additionally, The RDAD intervention did incorporate some behavioral and education techniques specific to dementia which may have improved implementation as there were positive outcomes in symptoms of depression.
while no change was noted in the functional domains. This leads one to conclude that complying with all aspects of the theoretical frameworks is essential for successful outcomes.

In efforts to overcome the limitations in some of these previous studies, and to build on the successes of others, some considerations were made in the current study. First, an overarching conceptual model was chosen (The Disablement Model) in order to better understand how an intervention might affect the illness and disability experience for an IWD. This assisted in both the design of the research study as well as the development of the intervention. In addition to this conceptual model, several principles were used to guide the development, implementation, and evaluation of the intervention: 1) guidance by the principles of exercise science in the development of the intervention (Physical Stress Theory), 2) accounting for the specialized needs of IWDs during implementation of an exercise intervention (Strength-Based Approach), and 3) ensuring alignment of intervention and outcomes during the evaluation of the intervention (specificity principle).

**Conceptual Model and Guiding Principles**

The initial phase of any intervention research includes a review of the current literature along with the formulation and development of specific testable hypotheses (Greenwald & Cullen, 1985). As previously discussed, the use of an appropriate conceptual model(s) is imperative in this first step of the intervention research process (Fraser & Galinsky, 2010). In the current study, The Disablement Process (Verbrugge & Jette, 1994) was used as the conceptual
model for research design and hypothesis testing. The *Physical Stress Theory* and *specificity principle* (Mueller & Maluf, 2002; vanBeveren & Avers, 2012) were be used to guide the development and evaluation of the exercise intervention while maintaining adherence to the foundational exercise science rationale of the American College of Sports Medicine (ACSM) and the Center for Disease Control (CDC) in exercise testing and prescription. Additionally, *the Strength-Based Approach* (K. S. Judge, Yarry, & Orsulic-Jeras, 2010; Orsulic-Jeras, Shepherd, & Britton, 2003; Yarry, Judge, & Orsulic-Jeras, 2010) guided the intervention development and implementation for the specialized population of IWDs, which takes into account difficulties in cognition and function unique to sample.

**Model for hypothesis testing.** Grounded in the literature related to the rehabilitative sciences are different conceptualizations of how a given pathology may impact an individual’s level of function. One of the most common frameworks used to understand the illness and disability process is the disablement model by Saad Nagi (Nagi, 1965, 1970), which came from work regarding rehabilitation potential and disability from a legal and compensative perspective. However, Nagi’s Model of Disability is considered relevant in other rehabilitation fields such as physical therapy, athletic training, and exercise science (Guccione, 1991; Jette, 2006; Jette & Keysor, 2003; Snyder et al., 2008). Nagi’s model provides increased clarity with respect to several key concepts surrounding the issue to disability which can allow researchers and clinicians
from multiple disciplines to communicate regarding these topics (Guccione, 1991).

Building upon the scheme conceived by Nagi (Nagi, 1965, 1970, 1976), The Disablement Process (Figure 1) was developed as a foundation for research design in social and medical research (Verbrugge & Jette, 1994). Disablement models attempt to explain and outline the consequences of pathology on functioning by providing a “conceptual map of causal pathways from a disease to the ensuing health-related consequences” (Jette & Keysor, 2003, p. 118).

The main pathway of this model restates the four central concepts of Nagi’s Model of Disability (pathology, impairments, functional limitations, disability) but introduces factors that may speed up or exacerbate the process as well as other factors that may reduce or slow it down (risk factors, intra-individual factors, extra-individual factors). This extension was made by Verbrugge and Jette (1994) as there are always social, psychological, or environmental factors that affect the process from pathology to disability. Going a step beyond typical disablement models, The Disablement Process posits pathways that exist that may explain how an exercise intervention could intervene upon different but related domains for IWDs.

**The main pathway.** The main pathway from pathology to disability includes four concepts, which are pathology, impairments, functional limitations, and disability. *Pathology* refers to “biochemical and physiological abnormalities that are detected and medically labeled as disease, injury, or congenital/developmental conditions” (Verbrugge & Jette, 1994, p. 3).
Pathologies can be either chronic conditions, such as neurodegenerative diseases, hypertension, or osteoarthritis, or acute pathologies that are less than 3 months in duration, such as an infection or muscle strain. In the current study, the pathology is considered the neurodegenerative disease leading to dementia (e.g., vascular dementia, Alzheimer’s disease).

Figure 1. The Disablement Process (Verbrugge & Jette, 1994)

Impairments result directly from the pathology affecting a specific system of the body. Effects from the pathology cross the clinical threshold and lead to dysfunction that have consequences on an individual’s ability to function (Verbrugge & Jette, 1994). Examples include pain and decreased range of
motion from arthritis, decreased kidney function from chronic renal disease, or decreased connectivity of the frontal lobe resulting from neuronal atrophy and synaptic dysfunction in Alzheimer’s disease.

*Functional limitations* describe the physical and mental restrictions that occur in generic abilities of the body and mind when attempting to complete a given task (Verbrugge & Jette, 1994). These can include walking, lifting objects, reading standard-sized print, stair climbing, and communicating with others. Functional limitations can be measured using a variety of modalities: 1) self-reports or proxy reports stating the amount of difficulty an individual has with the given task, 2) an interviewer’s observation of the given task, and 3) equipment-based evaluation of the individual’s performance of the given task (Verbrugge & Jette, 1994).

Secondary *functional limitations* also can result in The Disablement Process. Verbrugge and Jette (1994) posit that “a given disablement process can lead to downward-spiraling functions, and sometimes even prompt new pathologies and their associated dysfunctions” (p. 7), highlighting the potential for feedback loops to be present in the model. For example, IWDs have difficulties with cognition as their primary functional limitation; however, these difficulties may lead to reduced participation in ADLs and IADLs as well as leisure activities. This reduced physical activity may induce impairments in the musculoskeletal system such as reduced size of quality of muscle tissue along with reduced cardiopulmonary function or aerobic capacity. These secondary impairments can then lead to muscle weakness or changes in balance. These secondary
Impairments can have an effect on function and disability in addition to the primary neurodegenerative impairments associated with the pathology. The current study examined executive function as the primary functional limitation. In addition, lower-extremity strength, balance, and gait speed (comfortable and fast) were assessed as secondary functional limitations related to the dementia pathology.

*Disability* is “experienced difficulty doing activities in any domain of life due to a health or physical problem” (Verbrugge & Jette, 1994, p. 4). These domains include personal care (basic activities of daily living), household management (instrumental activities of daily living), job-related activity, social and leisure activities (e.g., sports and physical recreation, socializing with friends), or civic engagement activities (e.g., adult education, volunteering). The current study focuses on basic and instrumental activities of daily living to examine disability.

Disability is usually measured via self-reports or proxy reports to determine the degree of difficulty one has when completing activities in one’s regular environment (Verbrugge & Jette, 1994). It is important to distinguish that disability differs from dependence in this respect. Dependence, which is used in many studies, measures the presence of adaptations to prevent disability. However, disability assesses the individual’s perception of their abilities; therefore, “subjective [items] reveal the experience of disability in apt and direct manner” (Verbrugge & Jette, 1994, p. 5).

**Risk factors.** Risk factors are described as predisposing characteristics of the individual across multiple domains: demographic, social, lifestyle, behavioral,
psychological, environmental, and biological (Verbrugge & Jette, 1994). These risk factors usually present at or before the beginning of the disablement process and can affect the trajectory of each domain in the model. For example, education and socioeconomic status have been cited as variables that may affect the disablement process (Ferraro, Thorpe, McCabe, Kelley-Moore, & Jiang, 2006; Fiscella & Williams, 2004; Kazak, Bosch, & Klonoff, 2012; McIlvane, Baker, & Mingo, 2008). Other important risk factors may include marital status, education level, and prior level of exercise, which will be examined in the current study.

**Extra-individual and intra-individual factors.** Other factors that modify the pathway include interventions that impact the disablement process. These interventions can act either as “buffers”, which are aimed at reducing restrictions or difficulties, or “exacerbators”, which can prompt, promote, or maintain various limitations and dysfunctions. Usually interventions are meant to assist the individual (buffer) but can sometimes go awry and become an exacerbator. For example, side effects from a medication or pain resulting from an exercise program. Interventions can be categorized based on their locus of action as in The Disablement Process and can operate on all four concepts of the main pathway (Verbrugge & Jette, 1994).

**Extra-individual interventions or factors** come from outside the individual. These are generally medical interventions (e.g. pharmacology, rest, biofeedback, surgery), rehabilitative interventions (e.g., exercise and physical activity, physical therapy, occupational therapy, counseling, job retraining), external supports (e.g.,
personal support, respite care, equipment and devices, mobile meals), and environmental interventions (e.g., structural home modifications, job redesign, access to medical care). In the current study, the strength and balance program is considered an extra-individual factor and is hypothesized to act upon the main pathway through primary and secondary functional limitations as well as disability.

In contrast, intra-individual interventions or factors operate within the individual and are generally lifestyle and behavior changes, psychosocial attributes and coping (e.g., cognitive adaptation to one’s situation, coping strategies, peer support groups), and activity accommodations. For example, much research has been done on the effect of coping skills on health outcomes and disability. Individuals that exhibit more proactive coping skills are less likely to become disabled (Fiksenbaum, Greenglass, & Eaton, 2006; Greenglass, Fiksenbaum, & Eaton, 2006). It is often difficult to predict how an individual will respond to any given intervention due to the diverse nature of symptoms and dysfunction as well as the timing of the intervention as related to The Disablement Process. This can make it challenging for researchers to truly disentangle efficacious results from the intervention rather than other factors present, both intra- and extra-individual.

This model fits nicely with a lifespan approach to understanding the illness and disability experience as it allows for multiple directions and trajectories as well as accounting for the inter-individual differences that can occur through differential aging (Baltes & Danish, 1980). As mentioned, it is crucial to use an
overarching conceptual model to allow appropriate intervention development, implementation, and evaluation. While the Disablement Process assisted with hypothesis testing, other guiding principles were pivotal for the intervention.

**Principles guiding intervention development.** Exercise science. The gold standard for exercise prescription in any population is the guidelines from the ACSM along with the CDC (American College of Sports Medicine, 2013). Fitness professionals, exercise scientists, and clinicians commonly use these guidelines to assist with the development of exercise programs for patients and clients. However, older adults as well as IWDs pose unique challenges for clinicians and researchers, which could be a contributor as to why many studies do not include these guidelines. Deficits in attention, judgment, memory, communication, and language, which are common in individuals with dementia, may impede routine implementation of a standard progressive moderate- to high-intensity exercise program.

Additionally, older adults with lower levels of physical activity perceive more barriers to regular physical activity (Costello, Kafchinski, Vrael, & Sullivan, 2011). Some of these include intimidation by fitness facilities, lack of individualized tailoring of fitness programs, and need for activity to be purposeful and fun for the individual (Costello et al., 2011). If an exercise program could overcome these barriers, it may improve adherence, which is needed for successful outcomes. Needs of this special population should be considered while adherence to basic exercise science principles is maintained. For example, allowing a home-based exercise program to avoid the need for a
conventional fitness center or allowing for current leisure activities to be used as mode of exercise can increase adherence to an exercise program. Therefore, a standardization protocol through the concept of universal design, which incorporates exercise science principles, were the foundation of the current intervention while tailoring and flexibility was instituted to ensure needs for the sample are met. Two concepts embody the guidelines from the ACSM and CDC with regards to exercise prescription and were used in the current study: the Physical Stress Theory (Mueller & Maluf, 2002) and the principle of specificity of training or specificity principle (vanBeveren & Avers, 2012).

*Physical stress theory.* The Physical Stress Theory uses fundamental principles that govern the adaptive response to physical stress of tissues in the human body (Mueller & Maluf, 2002; vanBeveren & Avers, 2012). The goal of most exercise programs is to improve strength, balance, and/or cardiovascular fitness; therefore, a thorough understanding of these physiological changes that can occur in the human body is crucial to meeting this goal. The Physical Stress Theory encompasses the basic premise that “changes in the relative level of physical stress cause a predictable adaptive response in all biological tissue” (Mueller & Maluf, 2002, p. 385), through key fundamental principles (for full description of the Physical Stress Theory, see Mueller & Maluf, 2002). The major principles that were used to guide the current study posit that biological tissues such as muscle tissue, skin, and bone respond in a particular manner to a given amount of physical stress. Important to this line of research is the understanding that these physiological changes will happen in any individual with healthy tissue.
such as muscle; therefore IWDs will respond the same to physical stress (e.g.,
physical activity, exercise) as do cognitively intact older adults.

The Physical Stress theory states that if physical stress levels are lower
than maintenance levels, muscle tissue will be subject to decreasing tolerance to
later stresses (Mueller & Maluf, 2002). In terms of physical functioning,
individuals that do not remain active enough to maintain necessary levels of daily
activity (e.g., having caregivers assist with tasks more than needed or use
unnecessary assistive devices) may experience muscle atrophy leading to further
decline in strength, balance, or functional mobility (secondary functional
limitations). Whereas, physical stress levels that are in the maintenance or
“usual” range results (40-60% of maximal ability) in maintenance or no significant
change in tissue. In order to achieve positive and adaptive changes, physical
stress levels must be in excess of the maintenance range (60-100% of maximal
ability) to result in increased tolerance of tissues to subsequent stresses mostly
commonly via hypertrophy (Mueller & Maluf, 2002). The Physical Stress Theory
states that physical stress must surpass that of maintenance in order to provoke
changes in muscle and other tissues; therefore the concept of overload becomes
pertinent to ensure appropriate levels of resistance and intensity during exercise
task. Exercise interventions must provide a safe level of overload or resistance
to induce the beneficial changes of strength and balance, which are vital to
improvements in functional status.

This leads one to understand that exercise interventions that do not use
adequate levels of resistance or workload to stress the targeted tissues (e.g.,
60% of one repetition max (1RM)\(^1\) or 50-70% of heart rate max as recommended by the ACSM) risk not being able to elicit the adaptive response necessary to induce changes in strength and aerobic capacity. It is clear that many of the reviewed exercise interventions do not meet the criteria of the Physical Stress Theory to provoke necessary changes in the hypothesized outcomes; therefore are not developed to deliver a *sufficient dose* of physical stress needed to beneficially improve outcomes such as strength and aerobic capacity. Many did not even introduce external resistance or load to their participants, which may lead to either muscle atrophy or, at best, a maintenance of current level.

Additionally, the Physical Stress Theory posits that the level of exposure to a physical stressor is defined by multiple components of the applied stress such as magnitude, time, and direction (Mueller & Maluf, 2002). Time factors include the duration of the stress as well as the number of repetitions and the rate at which the stressor is applied to the body. It is well accepted that sufficiently resisted strengthening must be completed over a period of at least 6 weeks to elicit significant changes in muscle hypertrophy; however, strength gains are often seen prior to this 6-week timeframe due to inductions of motor learning and neural adaptation (vanBeveren & Avers, 2012). Avers and Brown (2009) suggest that significant physical changes occur over a 12 to 16 week period. Therefore, it is vital to ensure that an intervention is completed over an adequate period of time to allow for gains to be made because training effects

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\(^1\) A repetition maximum is determined by measuring the number of times an individual can move a specified amount of weight with good form. This can be used as a single or 1 repetition maximum or for multiple repetitions. This form of assessment has been the gold standard in strength assessment across multiple populations of individuals (vanBeveren & Avers, 2012).
may not be sufficient to elicit significant changes in pertinent outcomes reliant on these adaptive strength, balance, or aerobic improvements for interventions lasting under 12 weeks. Interventions that fall below these recommendations again risk non-significant findings due to poor adherence to these standards, as they may not sustain adequate duration to elicit changes for strength through muscle hypertrophy or the changes in aerobic capacity necessary for adaptations in cognition or psychological outcomes.

The final principle relevant to the proposed study states that stress thresholds (i.e., intensity and duration) needed to achieve a particular goal may vary due to individual differences in several moderating variables including movement and alignment factors (e.g., muscle performance, posture and alignment, physical activity), extrinsic factors (e.g., footwear, gravity, ergonomic environment), psychosocial factors, and physiological factors (e.g., medications, age, systemic pathology: (Mueller & Maluf, 2002)). The most relevant moderating factors pertaining to the current study are age and current level of physical as well as cognitive function. For example, slower rates of progression may be necessary in untrained or sedentary individuals upon initiation of an exercise intervention (Kraemer & Ratamess, 2004). Avers and Brown (2009) allow for initial workload of 15 RM\(^2\) (50% of 1RM) during the first week of training to focus on teaching the exercise protocol with increases to at least 60% of 1RM.

\(^2\) Fifty percent of an individual’s 1 RM is equivalent to that individual being able to complete 15 RM. For example, if a person can complete a 1RM on the leg press of 100 lbs., that individual should be able to complete 15 repetitions at 50 lbs. with significant fatigue and not be able to complete additional repetitions. Using 1 RM is ideal for strength assessment according to the American College of Sports Medicine; older adults may have a better response with a multiple RM assessment (vanBeveren & Avers, 2012).
of or at least 8-12 RM after safe and consistent performance is noted. Additionally, use of additional techniques for implementation to account for cognitive differences are important and were guided by the Strength-Based Approach discussed below. Understanding these individual differences, especially when intervening upon a clinical population of older adults, is essential to developing an intervention that allows the maximal level of involvement and success of the individual participants.

Specificity of training principle. Another important principle in the exercise science literature, specificity of training or task-specific training, should be raised regarding the choice of exercise protocol as well in the selection of outcome measures. This principle suggests that performance improvements will be greatest when the outcome measures and desired functional task performed mimic that of the activities completed during the intervention (vanBeveren & Avers, 2012). In other words, the intervention protocol must match the intended outcomes and vice versa. If the research design does not align the components of the intervention and the appropriate outcomes, evaluation of the intervention may not be valid. For example, if walking on even surfaces is the only mode of exercise in a given intervention then outcomes including other functional domains such as balance or transfers should not be included. If appropriate levels of overload are delivered, one may expect changes in gait speed, distance and/or quality but not necessarily in balance and strength due to the task-specific nature of the training.
Researchers must carefully choose outcome measures that align with intervention components and provide rationale for expectations of improvement in each measure. This must occur for each individual measure as well as on a more global construct level. Otherwise, non-significant results may lead readers to incorrectly conclude that exercise does not impact performance. In their position stand on exercise and physical activity for older adults, Chodzko-Zajko et al. (2009) attribute some of the conflicting evidence and mixed findings in the literature to the specific functional measures chosen as well as fidelity to the specificity of training principle.

In addition to the factors of age and level of prior training, it has been discussed that individuals with dementia possess cognitive deficits that may interfere with the implementation of a typical exercise program using standard gym equipment and instruction; therefore a Strength-Based Approach was used to ease implementation and success of the current intervention by capitalizing on the remaining strengths of IWDs and compensate for areas that may prove challenging.

**Strength-based approach.** It is sometimes assumed that IWDs face only loss and decline due to the neurodegenerative nature of most dementias; however, emerging research is urging clinicians and researchers to assess and capitalize on remaining strengths from multiple domains that may remain intact in order to allow individuals to maintain a level of activity in their own care (K. S. Judge, Yarry, et al., 2010; Yarry et al., 2010). This information should be used to facilitate optimal implementation of any intervention with this unique and
potentially challenging population of individuals. Researchers must tailor interventions to specific populations when needed in attempts to overcome potential barriers to implementation or protocol fidelity (Chen, Reid, Parker, & Pillemer, 2012). Successes from the social work and counseling disciplines can be drawn upon to potentially assist in the field of exercise. The Strength-Based approach has been found to be a beneficial tool for assessing and treating behavioral and psychosocial issues in individuals with chronic health conditions (Dahl, Bathel, & Carreon, 2000; George, Iveson, & Ratner, 1999; Gingerich & Eisengart, 2000; Kropf & Tandy, 1998; McKeel, 1996). This approach is best suited for individuals with progressive and irreversible pathologies as it focuses on remaining abilities rather than areas that may be challenged.

Central tenets of the Strength-Based Approach include 1) identifying strengths and abilities, rather than deficits and limitations (using familiar and functional activities that rely on procedural and long-term memory as exercises instead of new and unfamiliar fitness equipment); 2) including individuals as active rather than passive participants in treatment process (allowing the individual to choose the activity, such as ballroom dancing instead of walking on a treadmill); and 3) emphasizing current possibilities and options rather than past events and performance (encouraging continuation of enjoyed activities even if it will require some modification, such as addition of adaptive equipment for gardening) each of which will be discussed in more depth (K. S. Judge, Yarry, et al., 2010; Orsulic-Jeras et al., 2003).
The first tenet of the Strength-Based Approach urges that interventions developed for individuals with dementia capitalize on an individual’s remaining strengths to be successful. Despite declines in certain aspects of cognition, there are several domains that are relatively spared from the degenerative process. For example, while short-term and working memory require compensation early in the disease, portions of long-term memory remain relatively intact and should be exploited to optimize function in individuals with dementia as stated in the Strength-Based Approach. Previous basic research has found that procedural memory, a part of long-term memory, is one of the most powerful assets remaining through middle stages of the disease (Beaunieux et al., 2012; Lezak, 2004; Machado et al., 2009; Mahendra, Scullion, & Hamerschlag, 2011). This particular type of memory stores memories for skills, procedures, habits, emotional associations, and conditioned responses. Learning has occurred through automatic processes and repetition, so activities such as getting out of a chair, walking up and down stairs, or a long-time leisure activity would be available to individuals until later in the disease process. Subsequently using functional exercises, such as weighted sit to stand or walking on an uneven surface, may be easier for an IWD to complete than open-chain exercises such as a seated marching or hamstring curls, which are likely more unfamiliar and not readily available in long-term memory as activities previously completed.

Other cognitive domains that remain intact include reading, emotional memory, simple focused attention, and some aspects of language. Incorporating
these remaining strengths into an exercise intervention, as guided by the Strength-Based Approach, would focus on functional activities as the mode for exercises capitalizing on long-term memory (procedural memory) while also being able to implement strategies that rely on intact processes such as reading (e.g., written instructions) to compensate for declines and losses in short-term memory. For example, using a written form of instruction as an external memory aid could assist IWDs in independent performance of a particular exercise since they may have forgotten the verbal instructions from the practitioner given earlier in the session due to declines in short-term memory. Another example is “keeping it short and simple”, which capitalizes on simple attention while addressing deficits in short-term and working memory; therefore the intervention was designed to keep instructional cues during an exercise activity at a minimum (K. S. Judge, Yarry, et al., 2010). Also using activities that are familiar to the participant would reduce the amount of verbal instructions required. Learning by model and use of visual feedback has been found much more effective than typical trial and error learning with IWDs (Dechamps et al., 2011; K. S. Judge, Yarry, et al., 2010). Therefore, the use of demonstration instead of elaborate verbal instruction may improve consistency in performance with a new exercise for an IWD. Adding these techniques to the exercise intervention according to the Strength-Based Approach could improve implementation of an exercise intervention with this population.

Secondly, ensuring that the IWD is an active participant in the process is crucial in developing a successful intervention. Facilitating active participation by
allowing the IWD to choose the mode of activity to be completed is a simple way to incorporate this principle into an exercise intervention. For example, giving the IWD a choice between 2 to 3 activities or allowing them to use a long-time leisure activities such as dancing or gardening as techniques for exercise may engage the individual and provide more enjoyment improving adherence (Costello et al., 2011). These types of activities can be easily modified to encourage the necessary amount of overload to elicit adaptive changes in strength, balance, and aerobic capacity to intervene on IWDs.

This leads to the third and final tenet of the Strength-Based Approach, which emphasizes focusing on current possibilities rather than on past performance. An IWD may not believe that he/she may continue to complete any given leisure activity or exercise because of declines in physical or cognitive abilities. It is important to encourage highest level of performance at current capacity with appropriate modifications of activity to facilitate success. For example, an activity such as walking the dog may need to completed using an assistive device such as a cane or walker to ensure proper balance, but it will be emphasized that it can still be done at a level necessary to induce an aerobic effect as often times these activities will be effortful enough to elicit a cardiovascular response. Additionally, simple modifications to a strength or balance activity, such as allowing the individual to hold on to a surface, were implemented as needed during each session to maximize successful completion of the exercise.
The Strength-Based Approach provides challenge and meaning for the IWD while presenting the individual with tasks that can be successfully completed (Yarry, Dawson, & Judge, 2011). Keeping these principles in mind during intervention development in addition to following this approach during implementation should lead to increased enjoyment and improve treatment adherence (Costello et al., 2011). The current intervention was guided by an understanding of those areas that remain intact during the disease process (e.g., procedural memory and reading skills) and those that require compensation (e.g., short-term memory and working memory) in order to best capitalize on the individual’s remaining strengths and appropriately design techniques to improve implementation due to deficits.

In summary, the current exercise intervention contained components that align with theory in order to be most appropriate for use with individuals with dementia. It provided adequate workload (at least 60% of 1RM or 50-70% of heart rate max) through resistance or some other form of challenge to balance and postural stability to elicit adaptive responses in the body, such as changes in balance, strength, or aerobic capacity. Sufficient frequency and duration (2 times per week for strengthening and/or 5 days per week for aerobic training for at least 12 weeks (American College of Sports Medicine, 2013)) were met to ensure gains in targeted domains. Finally, while a standardized protocol (universal design) was followed using these exercise science principles as a foundation along with the tenets of the Strength-Based Approach to ease implementation, flexibility was considered due to individual needs of each participant. For
example, allowing for slower rates of training initially for more frail or sedentary individuals. Additionally, the program allowed progression to continually challenge and properly stress the tissue through overload is necessary for successful outcome. Interventions that do not possess these basic components may not adequately meet the needs of individuals with dementia to meet goals of improving cognition and functional performance.

**Purpose of Current Study**

There are three aims for the current study: 1) to develop a moderate-intensity home-based functional exercise program for IWDs adapted from the HIFE protocol (Littbrand et al., 2006); 2) to evaluate the acceptability and feasibility of this intervention; and 3) to test the efficacy on multiple outcomes using a randomized, controlled trial.

The first aim of the current study was to develop a home-based exercise intervention for individuals with dementia guided by the Physical Stress Theory, specificity principle, and the Strength-Based Approach using moderate-intensity functionally based exercises adapted from previous research. The limitations of previous interventions led to the proposal of this new program as the initial phase for research utilizing the current exercise intervention. This first phase included review of current literature to also identify factors that are amenable and modifiable via intervention to aid in the formulation and development of hypotheses using the Disablement Process (Greenwald & Cullen, 1985; Verbrugge & Jette, 1994). Additionally, the identification of the appropriate guiding principles, such as the Physical Stress Model and specificity principle
along with the Strength-Based Approach, was imperative in this first step of the intervention development process (Fraser & Galinsky, 2010).

Additionally, key features of the intervention were identified at this phase, such as level of intervention, setting of the intervention, and the intervention agent (Fraser & Galinsky, 2010). It is important to identify these key areas early in the process, as they will most certainly affect the way the intervention is designed and implemented. In the current proposed study, a home-based intervention has been chosen, as it will allow for easier accessibility for the dyad as well as improved familiarity for the IWD in efforts to promote higher levels of adherence (Costello et al., 2011). It also was determined that a trained exercise practitioner would deliver the exercise intervention to maximize fidelity to the exercise science principles outlined above.

In addition to early stage of theoretical development and conceptualization, the current study addressed intervention development, implementation, and evaluation through efficacy testing (Fraser & Galinsky, 2010; Greenwald & Cullen, 1985). Intervention development and design includes development of each session’s components and essential content, intervention goals, and training manual creation to improve fidelity to the program. The second aim of the current study was to evaluate the acceptability and feasibility of the intervention as applied to community-dwelling IWDs.

The final aim of this study examined the efficacy of this exercise program on various outcomes including functional limitations (executive function, strength, balance, and gait speed) and disability (perceived ADL function) resulting from
the neurodegenerative pathology. During this third stage of intervention research, focus should be on internal validity with higher levels of control in efforts to identify causal link between the intervention and outcome measures (Greenwald & Cullen, 1985). While a higher control may be available in a laboratory setting such as consistent equipment or environmental circumstances (e.g. distractors, temperature, open space), Glasgow, Lichtenstein, and Marcus (2003) suggest that environmental factors need to be considered earlier in the research process to allow for improved translation to later effectiveness studies and dissemination. In the current study, a home-based intervention was the ultimate intention; therefore, this setting was utilized from the initial development and efficacy trials in attempts to allow for smoother translation later in the research process.

**Research Questions**

1) Is a moderate-intensity home-based functional exercise program acceptable and feasible with a sample of community-dwelling IWDs?

2) Can IWDs participate in a home-based functional strength and balance program at the recommended dosage?

**Hypotheses**

1) Participants in the exercise program will demonstrate significantly improved cognitive function (primary functional limitation), specifically executive function, as demonstrated by performance on the Trail Making Test (Part B) compared to participants in the comparison group.
2) Participants in the exercise program will demonstrate significantly improved balance (secondary functional limitation), as demonstrated by performance on the modified Berg Balance Scale, compared to participants in the comparison group.

3) Participants in the exercise program will demonstrate significantly improved lower-extremity strength (secondary functional limitation), as demonstrated by the 30-second Chair Stand test compared to participants in the comparison group.

4) Participants in the exercise program will demonstrate significantly improved comfortable and fast gait speed (secondary functional limitations), as measured by the 8-foot walk test, compared to the participants in the comparison group.

5) Participants in the exercise program will report significantly less difficulty during activities of daily living (disability) compared to participants in the comparison group.
CHAPTER II

METHODS

Study Design

The current study was a randomized, controlled intervention trial with a two-group pre-test and post-test design. The time between data collection points was a 12-week period in which one group received a moderate-intensity, functional strength and balance exercise program. The study was approved by the Institutional Review Board at Cleveland State University (#30134-JUD-HS).

Measures

Demographic, health, and inclusion information. Demographic and health information including age, gender, marital status, relationship to caregiver, and past medical history was obtained via self-report questionnaire (see Appendix A). Participants were asked to rate their overall health on a 4-point Likert scale (poor, fair, good, excellent), as well as provide highest level of
education completed, and previous level of weekly exercise measured in minutes reported by the participant.

**Mini-mental state examination.** The MMSE (Appendix B) is a standardized mental status examination that simply and quickly assesses a restricted set of cognitive functions (working memory, language and praxis, orientation, memory and attention), taking the examiner about five to 10 minutes to complete. MMSE performance predicts important functional outcomes such as medication adherence, length of rehabilitative needs, and outcomes (Lezak, 2004). A score of less than 24 out of 30 possible points is considered abnormal. Test-retest reliability of the MMSE is high at 0.89 for intra-tester reliability and 0.83 for inter-tester reliability (Folstein, Folstein, & McHugh, 1975). In the current study, the MMSE was used to exclude participants with severe cognitive impairment indicated by a score less than 7 out of 30 as well as to provide sample descriptors.

**Acceptability and feasibility measures.** Acceptability and feasibility of the current intervention with a sample of community-dwelling IWDs was assessed using multiple measures. Acceptability was measured via treatment adherence, tolerance to the intervention, and exercise-practitioner session evaluations. Feasibility also was examined via exercise-practitioner session evaluations.

**Treatment adherence.** In order to monitor and quantify adherence as well as determine acceptability of the intervention to this sample, attendance and participation of the home-based functional strength and balance program were
recorded. The trained exercise practitioner maintained attendance for the functional strength and balance program. In addition to being a measure of acceptability by the participant, treatment adherence also was used as a measure of fidelity to assure that the appropriate dose of the intervention (24 sessions) was delivered to each participant.

**Intervention tolerance.** Intervention tolerance was examined by monitoring the occurrence of any adverse events. This method is consistent with previous literature and allows the researchers to identify any discomfort, pain, or injury to the participant that is attributed to participation in the exercise program. Any adverse events were recorded during each session and defined as “discomfort that manifested itself or became worse because of the exercises” (Littbrand et al., 2006, p. 494). An adverse event was recorded if expressed by the participant or changes in performance were noted by the practitioner. If an adverse event was noted, the practitioner rated it as either temporary and minor or serious and major. If an adverse event was rated as serious and major, the principal researcher was to be notified immediately to determine whether modifications needed to be made. These modifications made include a temporary reduction in intensity, alterations in range of motion excursion during a given exercise, or avoidance of certain exercises.

**Exercise-practitioner session evaluations.** Following each session, the exercise practitioner evaluated the implementation of the intervention across several key areas (Appendix C). The first portion of the evaluation measures practitioner-observed levels of the participants’ ability to complete the session.
(acceptability). It included level of engagement during the session, levels of frustration exhibited by the participant, and the participant’s ability to perform the protocol within the given parameters at the prescribed intensity. Additionally, the exercise practitioners evaluated their own ability to implement the intervention as outlined in the protocol manual (feasibility). Acceptability of the intervention protocol also was examined after completion of each session by the exercise practitioners who rated their own level of confidence and enjoyment when implementing the protocol. Each question was answered on a 4-point Likert scale (0= not at all, 1= some of the time, 2= most of the time, 3= for the entire session).

A final measure of acceptability included a question posed to the participant following the last session of the program. Participants were asked “how much did you enjoy the program?”. Response categories included “not at all”, “a little bit”, “it was okay”, or “loved it, it was great” in efforts to ascertain an overall level of enjoyment of the exercise program.

**Intervention fidelity measures.** It is important to examine whether the participants were able to complete the program at the prescribed dosage. This not only included the number of prescribed sessions (treatment adherence), but also ensuring that each session was completed at the prescribed intensity. Fidelity to this part of the protocol was first examined by assessing participants’ ability to perform the prescribed exercises that were paired to their assigned Physical Function Group, which will be discussed in detail during the Procedure (see Table 3). For example, if after the baseline assessment, the participant was assigned to Physical Function Group 1, the prescribed exercises should have
been chosen from categories A and B. On each session’s log, the exercise practitioner indicated the assigned Physical Function Group as well as the exercise categories used during each session to allow fidelity monitoring.

Additionally, the session log completed by the exercise practitioner included the number of RM completed for each strength exercise and the time completed for each balance activity. The goal, following a 2-week acclimation period, was 8 to 12 RM for strength exercises and one minute for each balance activity.

Outcome measures. Primary functional limitation: executive function. Trail making test (part B). The Part B form of the Trail Making Test (TMT-B: Appendix D) was used to assess components of executive function that represent cognitive flexibility and complex attention (Arbuthnott & Frank, 2000; Lezak, 2004; Reitan, 1958). The TMT-B is a timed task with the participant alternating between 13 consecutively numbered and 12 consecutively lettered circles (1-A-2-B-3-C. . .). These lines should be drawn “as fast as possible” without lifting the pen/pencil from the paper (Lezak, 2004). Participants were instructed to begin at the number 1 and continue by connecting dots in order while alternating between numbers and letters. The researcher demonstrated proper technique prior to beginning used an abbreviated sample TMT-B. Any errors were identified immediately and corrected while the timer was kept running.

Higher scores (longer time to complete) reveal greater impairment. In general, reported reliability coefficients vary but most are in the .80 range (Lezak,
Poorer performance on Part B has been linked to decreased executive function leading to difficulty with complex activities of daily living (Lezak, 2004).

**Secondary functional limitations: lower-extremity strength, balance, and gait speed.** 30-second chair stand test. The 30-second chair stand test (Rikli & Jones, 2013) was used to assess lower-extremity strength (Appendix E). Eriksrud and Bohannon (2003) reported the correlations of the knee extension muscle force measurements with sit to stand success ranged from .65 to .71 without the use of hands and from .55 to .64 for those using their hands to stand. The sit to stand test has been used to successfully detect the effects of exercise programs for individuals with dementia (Santana-Sosa et al., 2008).

The participant began sitting in a standard armchair with feet flat on the floor and arms crossed over chest. The participant was asked to practice one or two stands prior to testing to ensure understanding of test protocol. Visual demonstration was given as needed. On the signal “go”, the participants were instructed to complete as many full stands as safely possible in 30 seconds (Rikli & Jones, 2013). Credit was given if participant is more than halfway standing at the end of 30 seconds (Rikli & Jones, 2013). If the participant was unable to complete without use of hands, modifications to protocol were noted in the assessment.

**Modified berg balance scale.** The Modified Berg Balance Scale (mBBS: Appendix F) is an abbreviated version of the original 14-item scale used to assess balance in older adults as well as monitor changes over time. The 11 items in the mBBS include items with varying base of support as well as both
static and dynamic balance activities. The modified version excludes 3 items found in the original assessment: chair-to-chair transfer, forward reach with outstretched arm, and alternate stepping on-off stool to allow brevity, consistency, safety, and ability to convey instructions when testing participants with cognitive impairment (Kenny et al., 2008; McGough et al., 2013). The score on this test ranges from 0 to 44 with higher scores indicating better balance.

8-foot walk test. The 8-foot walk test (Bohannon, 2008; Guralnik et al., 1994) was used to assess the participants’ walking speed at both a comfortable speed and at a fast pace (Appendix G). An 8-foot unobstructed walking course was identified in the participant’s home with the participant beginning with their toes behind the starting line. Timing began once the participant crossed the start line and stopped once their first foot touched the floor beyond the end line. Participants were able use assistive devices if needed. Two trials were completed with the participant being asked to walk at a “comfortable and normal pace” as well as two trials “walking as fast as you safely can”. The average of the two trials were used as measures of comfortable walking speed and fast gait speed.

Disability: perceived ADL function. Activities of daily living. A 16-item self-report assessment tool (Appendix H) was used to assess perceived difficulty across both basic activities of daily living (ADLs), such as toileting, grooming, and bathing, and instrumental activities of daily living (IADLs), such as finances, leisure activities, and meal preparation (Benjamin Rose Institute, 1992, 1998; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton & Brody, 1969).
Verbrugge and Jette (1994) state, “the standard, and only economical, procedure [to measure disability] is to interview individuals about difficulties (self-reports or proxy reports) with simple ordinal or interval scoring degree-of-difficulty” (p. 5).

Participants asked to report their level of difficulty with the given activity on a 4-point Likert scale (0=no difficulty, 1=a little amount of difficulty, 2=a fair amount of difficulty, 3=very difficult) with higher scores indicating greater perceived difficulty in completing ADLs and IADLs. The factor structure identified a single factor for the 16-item scale with most items having greater than 0.4 factor loading. This scale has demonstrated good internal consistency (Cronbach’s α > 0.80) when used with IWDs in previous research (Dawson, Powers, Krestar, Yarry, & Judge, 2013) as well as in the current study with 0.74.

**Participant Screening**

Participants for the current study were recruited from the Greater East Ohio Area Chapter of the Alzheimer’s Association. When necessary, staff obtained consent for the release of information from the participant and the caregiver. Potential participants were contacted via telephone by the principal researcher and screened for inclusion and exclusion criteria using the Telephone Screening Form (Appendix I).

**Inclusion criteria.** Inclusion criteria for participants was the age of 50 or older, community dwelling, able to walk household distances with or without assistive device but without physical assistance to allow for completion of necessary assessments, be experiencing memory impairment affecting daily activities, and complete the Mini-Mental State Examination (MMSE) with a score
of 7 or higher to demonstrate potential to complete intervention protocol (Dick et al., 1984; Folstein et al., 1975; K. S. Judge, Yarry, et al., 2010; Tombaugh & McIntyre, 1992). The final criteria was having an available caregiver to attend and witness each exercise session as well as assist during particular portions of the protocol that require a second person.

**Exclusion criteria.** Exclusion criteria for participation in the current study were the presence of other neurological or myopathic conditions (Parkinson’s disease, brain tumor, traumatic brain injury, muscular dystrophy, myositis ossificans) or score of less than 7/30 on the MMSE (Bass, Clark, Looman, McCarthy, & Eckert, 2003; Bass & Judge, 2003; Brod, Stewart, Sands, & Walton, 1999; Whitlatch, Judge, Zarit, & Femia, 2006).

**Participant recruitment.** Several methods of recruitment were used to identify potential participants appropriate for screening. Contacts with staff from the local chapter of the Alzheimer’s Association yielded both direct referrals along with opportunities to attend local events to advertise the current study. These events included multiple caregiver support groups throughout the targeted geographic region as well as various community events sponsored by the Alzheimer’s Association (e.g., workshops regarding early detection and the Walk to End Alzheimer’s). Finally, calls were made from the chapter office to possible participants identified from the HelpLine database.

The recruitment flowsheet is found in Figure 2 outlining recruitment methods and activities. Of the over 200 contacts made, the principal researcher spoke with 53 potential participants or their caregiver via telephone to discuss the
current study. The remaining contacts did not lead to potential participants as there was a message left with no return call, no interest in speaking with the researcher further, or the IWD lived out of the area. Following this initial contact, 20 individuals were either not interested in participating in the described study or unable to do so due to travel plans. Therefore, 33 individuals were screened using the Telephone Screening form (Appendix I) with four not meeting the criteria for participation and two others withdrawing interest in participants after initial interest. This resulted in a total of 27 participants were enrolled in the current study.

**Procedure**

Once a potential participant was identified and referred for the current study, an initial screening was completed via telephone to ensure that the participant understands the procedure for the study and that no reason for exclusion can be easily identified (e.g., existing comorbid conditions, lack of caregiver involvement for exercise program, or inability to ambulate). If the potential participant met this initial criterion per the Telephone Screening Form, an appointment was scheduled for the baseline assessment to be completed at the participant’s home by researchers. The participant flowsheet (Figure 2) outlines recruitment and randomization.

At the initial appointment, informed consent was received from both members of the dyad. The MMSE was then administered to ensure that the participant met remaining criteria for the current study. If the patient met all criteria for the study, a baseline assessment was completed. If the MMSE cut-off
Figure 2: Recruitment Flowsheet
of 7 out of 30 was not met, the participant and caregiver were thanked for their
time and the session concluded.

The baseline assessment included the completion of the demographic and
health information questionnaire, TMT-B, 8-foot walk test, modified Berg Balance
Scale, 30-second chair stand test, and the activities of daily living scale.
Following the baseline assessment, participants were randomized into either the
intervention or comparison groups. It should be noted that the first 3 participants
were assigned to the intervention group in order to pilot test the protocol.

If the participant was assigned into the intervention group, the initial
exercise session was scheduled at the conclusion of the baseline assessment. A
notification of participation was faxed to the participant’s primary care physician
(Appendix J) to alert the physician of the individual’s participation in the exercise
program. A confirmation of transmission was received by the principal
researcher to ensure the successful transmission of each notification form.
Additionally, the assigned exercise practitioner was notified along with being sent
a Summary of Baseline Performance (Appendix K). This communication served
to alert the practitioner regarding baseline physical functioning, any important
medical information, and Physical Function Group assignment. The Physical
Function Group (Table 3) assignment was based on performance of ambulation
without an assistive device over a short distance and was important in
determining the appropriate starting point for exercises. Assignment of Physical
Function Group is discussed further under the description of the intervention.
Regardless of intervention or comparison group assignment, a follow-up assessment including the TMT-B, 8-foot walk test, modified Berg Balance Scale, 30-second chair stand test, and the activities of daily living scale was completed following the 12-week period. At the conclusion of the follow-up assessment, the participants were provided information regarding physical activity and exercise including the book *Exercise & Physical Activity* published by the National Institute on Aging. All participants and their caregivers were invited to an educational workshop led by the research team.

**Pilot testing.** As mentioned above, the first 3 participants enrolled in the study were assigned to the intervention group for pilot testing of the intervention protocol. The primary goal of the pilot testing was to refine the intervention protocol in the context of practice (Fraser, Richman, Galinsky, & Day, 2009). No significant changes were made to the protocol as a result of pilot testing. The only modification was a re-organization of the exercise list to ease progression for the exercise-practitioner.

**Research team.** All baseline, follow-up assessments, and pilot exercise sessions were completed by the principal researcher (ND). Remaining exercise sessions were led by an exercise practitioner, either the principal researcher (ND) or a trained exercise specialist (HG). The principle researcher is a Board Certified Geriatric Physical Therapist and a doctoral candidate in Adult Development and Aging Psychology. The other trained exercise specialist is a Certified Strength and Conditioning Coach and a Certified Health Fitness
Specialist through the American College of Sports Medicine. He holds a Master’s degree and currently a doctoral student in Exercise Physiology.

The training for the exercise specialist included two 2-hour in-person training sessions regarding dementia specific information as well as reviewing various journal articles relating to the topic of exercise interventions for IWDs. Additionally, the intervention manuals (Participant & Care Partner Information Packet: Appendix L and Practitioner Exercise Protocol Manual: Appendix M) and the Practitioner Session Log (Appendix N), which were developed by the principal researcher for this intervention, were reviewed in detail. This review and training included the proper usage with the participant and caregiver as well as its completion during sessions. Following the initial training sessions, the exercise specialist shadowed the principal researcher during one week of implementation including the initial session. Following this observation period, the exercise specialist completed two weeks of implementation while being observed by the principal researcher. Throughout the intervention implementation, regular contact via e-mail, phone/text, and in-person meetings were completed to maintain a level of communication regarding study protocol and implementation.

**Intervention group.** The current intervention was a home-based exercise program consisting of two main components (moderate-intensity functional strength and balance exercises) while including techniques to improve implementation of program due to specialized needs of IWDs. The intervention developed for the current study was adapted from the HIFE (high-intensity functional exercise) program.
functional exercise) protocol (Littbrand et al., 2006; Rosendahl et al., 2006), which was originally developed for the Frail Older People – Activity and Nutrition Study in Umeå (the FOPANU Study) at Umeå University, Sweden. This original program was completed in a nursing home setting and was implemented in a small group (3-7 individuals) using two licensed Physical Therapists leading each group. The current intervention was delivered on an individualized basis with IWDs residing in the community.

Similar to the HIFE program, the current intervention is comprised of a functional strength and balance training program. However, the current intervention protocol modified the HIFE program by incorporating principles from exercise science (the Physical Stress Theory (Mueller & Maluf, 2002) and specificity principle (vanBeveren & Avers, 2012)) along with recommendations from the ACSM and CDC. Additionally, guided by the Strength-Based Approach, the current intervention used a universal design to ease implementation for IWDs (K. S. Judge, Yarry, 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 individually (rather than in a small group setting) in the participant's home by a trained practitioner (ND or HG), with occasional assistance from the caregiver, two times per week lasting 12 weeks for a total number of 24 sessions. Each of these practitioner-led sessions was comprised of four elements: Review, Education, Planning, and Activity. This approach to the development of the current intervention provided a significant amount of standardization and structure, through the use of the
universal design features, for the exercise practitioner, while allowing flexibility to ensure individualized tailoring as needed for each session. The HIFE protocol was implemented by licensed Physical Therapists, which likely allowed for increasing amounts of clinical judgment and skill during each session; therefore less standardization may have been required. Table 1 outlines the elements of the current intervention. The Practitioner Exercise Protocol Manual, designed specifically for this study, can be found in Appendix M.

**Review.** During the review portion of the session, the practitioner reviewed results from previous sessions as well as discussed concerns and barriers encountered by the participant. Participants and their caregivers were encouraged to record and document any questions or concerns between session in the Participant and Care Partner Information Packet (Appendix L), which was issued to each participant at the initial session. Additionally, assurance that no adverse events occurred since the last session was completed during the review portion of each session. The practitioner recorded this information for each individual session in the Practitioner Session Log (Appendix N). If any adverse event occurred, other than temporary symptoms, which had resolved, the principal researcher was contacted prior to continuing with the session to determine appropriate next steps. This could include simple modifications to the exercises to possibly rescheduling the session in order to contact the participant’s physician for further assessment if needed.

**Education.** At the initial session, education regarding the purpose of the intervention as well as thoroughly outlining the roles and expectations of the IWD
<table>
<thead>
<tr>
<th>Session</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1 (Week 1)</td>
<td>Practitioner will explain purpose of intervention and answer any questions regarding intervention. Assent will be received from IWD or CG.</td>
</tr>
<tr>
<td>Sessions 2-4 (Weeks 2-4)</td>
<td>Practitioner will ensure completion of all components of session. Assent will be received from IWD or CG.</td>
</tr>
<tr>
<td>Sessions 5-24 (Weeks 5-24)</td>
<td>Practitioner will ensure completion of all components of session. Assent will be received from IWD or CG.</td>
</tr>
</tbody>
</table>

**Table 1. Exercise Session Components**

- The table outlines the components of exercise sessions, categorized by session (Week 1, Weeks 2-4, Weeks 5-24), and includes activities such as identifying barriers, reviewing sessions, and ensuring the completion of all components.

- The table emphasizes the importance of participant engagement and assent throughout the sessions, ensuring that all components are successfully completed.

- The specific details within each session are tailored to facilitate a comprehensive understanding of the exercise components, with a focus on participant interaction and oversight.
and CG in the intervention was completed (see Participant and Care Partner Information Packet: Appendix L, page 5). The participant was expected to participate in the exercise program to the best of their ability. Also, the participant was asked to alert the exercise practitioner of any pain, frustration, or need for rest. The caregiver was advised that they might be asked to assist with the exercise program. For example, if a second person was needed during a balance exercise to ensure safety, the caregiver would act as the second person. Finally, the caregiver was asked to assist the IWD keep track of any questions or concerns between sessions.

Assent was always received from the IWD prior to progressing the session further. On subsequent visits, the education portion was tailored to allow the dedicated time necessary to answer any questions or concerns had by the IWD or CG, review prior information, and address additional needs of the dyad. All questions and concerns were recorded in the Practitioner Session Log.

**Plan.** A plan was developed utilizing techniques to overcome the potential barriers identified during the review portion of the session. These techniques were selected to improve adherence and enjoyment of the program based on the Strength-Based Approach. In order to account for needs of this special population, enhancement techniques based on a Strength-based Approach were included in the design and implementation of the intervention. While a universal design was used in the overall development of the intervention, specific techniques were available during each session (Table 2). For example, the universal design included training in techniques such as using one- or two-step
instructions for completion of activities (keeping it short and simple) as well as allowing the participants to have choices in completed activities will be stressed. However, other techniques such as use of external memory aids (e.g., written instructions, spots for foot placement) to compensate for deficits in short-term memory were implemented on an as needed individual basis.

Table 2. Use of Implementation Techniques Based on Strength-Based Approach

<table>
<thead>
<tr>
<th>Strength-Based Approach Technique</th>
<th>Potential Barriers</th>
<th>Cognitive Strength Being Used</th>
<th>Example of Applied Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping it Short &amp; Simple (K.I.S.S)</td>
<td>Frustration; inability to complete activity properly</td>
<td>Procedural memory; language comprehension</td>
<td>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”</td>
</tr>
<tr>
<td>External Memory Aids</td>
<td>Poor adherence despite willingness to participate; repetitive questions or demonstration</td>
<td>Simple attention; reading</td>
<td>Use of calendars; use of written instructions for exercises; use of visual cues (spots) for foot placement</td>
</tr>
<tr>
<td>Learning by Modeling</td>
<td>Frustration; inability to complete activity properly</td>
<td>Procedural memory; visuospatial functioning</td>
<td>Demonstrating activity with participants instead of relying on verbal cues only</td>
</tr>
<tr>
<td>Allowing IWD to Choose Activity</td>
<td>Boredom; poor adherence</td>
<td>Procedural memory</td>
<td>Giving IWD choice of 2 possible activities</td>
</tr>
<tr>
<td>Using Familiar Activities or Hobbies in Exercise</td>
<td>Boredom; poor adherence; inability to complete activity properly</td>
<td>Procedural memory</td>
<td></td>
</tr>
</tbody>
</table>

**Activity.** The *activity* element of the session consisted of functional strengthening and balance activities led by the exercise practitioner with
assistance from the caregiver, as needed. These activities were designed to use the overload principle of the Physical Stress Theory as well as the specificity principle to challenge the whole neuromuscular system rather than simply challenging a muscle in addition to balance exercises which are aimed to improve dynamic mobility (vanBeveren & Avers, 2012). These functional activities also provided increased familiarity relying on intact procedural and long-term memory per the Strength-Based Approach. Each exercise in the functional strength and balance component of the intervention had a hierarchy of three to four progressive steps to allow selected activities to become easier or more challenging based on response of participant (a full list of exercises can be found in Appendix O). Examples of a functional strength exercise include standing up from a chair which could easily be made more challenging by adding resistance or lowering the surface; or if the participant initially required use of hands to push up from chair, one could progress to not using hands. Some exercises can be found in the original HIFE program (Littbrand et al., 2006); however, several were added to increase the variety and difficulty of the exercises as well as add an additional level of progression to plyometric training for higher functioning community-dwelling participants in the current study.

Initial starting exercises were determined based on performance during the baseline walking performance as developed by Littbrand et al. (2006) for the HIFE protocol (see Table 3). Based on the participant’s ability to ambulate a short distance (5 to 10 meters) without use of an assistive device, an initial Physical Function Group was assigned. This assigned Physical Function Group
determined the categories of exercises that would be completed at each session. For example, if an individual was independent and safe with ambulation at the baseline assessment, the highest category of exercises would be completed (e.g., lunges, step-ups, stepping over obstacles); whereas individuals that required a significant amount of assistance for ambulation (without the use of an assistive device) would begin the program at a much lower level of intensity (e.g., heel raises, continuous walking). Within each of these categories, the practitioner and participant chose selected exercises (see Table 4 and Appendix O for full list of exercises) based on his or her individual needs and preferences.

### Table 3. Recommended Initial Exercise Categories

<table>
<thead>
<tr>
<th>Physical Function Group&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Recommended Categories in the Collection of exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking without any physical support or supervision</td>
<td>A. Static and dynamic balance exercises in combination with lower-limb strength exercises</td>
</tr>
<tr>
<td></td>
<td>B. Dynamic balance exercises in walking</td>
</tr>
<tr>
<td>Walking with supervision or minor physical support from 1 person</td>
<td>A. Static and dynamic balance exercises in combination with lower-limb strength exercises</td>
</tr>
<tr>
<td></td>
<td>B. Dynamic balance exercises in walking</td>
</tr>
<tr>
<td></td>
<td>C. Static and dynamic balance exercises in standing</td>
</tr>
<tr>
<td>Walking with major physical support or not able to walk</td>
<td>C. Static and dynamic balance exercises in standing</td>
</tr>
<tr>
<td></td>
<td>D. Lower-limb strength exercises with continuous balance support</td>
</tr>
<tr>
<td></td>
<td>E. Walking with continuous balance support</td>
</tr>
</tbody>
</table>

<sup>a</sup>The participant’s need for personal support when walking a short distance (5-10 meters) without walking aid (Littbrandt et al., 2006).
Table 4. Collection of Exercises: Categories and Examples

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

Note. See Appendix O for full list of exercises along with progression.

During the practitioner-led sessions, the CG participated whenever a second person was needed to complete the activity to allow the practitioner to guard the participant appropriately. For example, if the balance activity included throwing or passing a medicine ball to challenge balance, the CG acted as the partner for the exercise. This involvement allowed the practitioner to further challenge the participant's balance while maximizing the safety of the participant.

The intensity of each session was self-paced; however participants were regularly encouraged and coached by the practitioner to perform each exercise at highest level that can be safely completed (Littbrand et al., 2006). The goal for each session was completion of two functional strengthening activities from category A or D depending on initial performance (e.g., sit to stand, floor to
stand, bridging progress) and two balance exercises from category B, C, or E depending on initial performance (e.g., standing with narrow base of support, walking on uneven surfaces, stepping over obstacles). Over the first two weeks of the program, 15 RM (50% of 1RM)\(^3\) was targeted to allow acclimation to exercises and act as a build-up process (Avers & Brown, 2009; Littbrand et al., 2006). Target intensity of strength exercises following this initial phase was eight to 12 RM (60-80% of 1RM); therefore as more repetitions can be completed, the exercise intensity was increased as appropriate. Once a 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 (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. If a participant did not verbally indicate the inability to perform further repetitions, but demonstrated any of the following: muscle failure, loss of safe form, only able to say a few words at a time (Talk Test (Persinger, Foster, Gibson, Fater, & Porcari, 2004)), maximum repetitions achieved on strength exercise (20 or 25 repetitions), or indication of pain, the exercise practitioner terminated that set of exercises.

\(^3\) As footnoted in the Physical Stress Theory section, 15 RM is using the resistance to allow the participant to complete 15 repetitions to fatigue. Fifteen RM is similar to 50% of an individual’s 1 RM or the maximal amount of weight an individual can move with good form.
The procedure for the exercise portion of each session included alternating two strength and two balance exercises following a brief warm-up (the full scripted protocol can be found in the Practitioner Exercise Protocol Manual: Appendix M). Participants were then given a choice of two exercises from the respective exercise category. For example, at the time of the first strength exercise, the IWD was asked “Here are two examples of the strength exercises designed for you: lunges (demonstrated by practitioner) or step-ups (demonstrated by practitioner). Which one would you like to start with?” The participant would select the activity and the proper intensity was chosen by the practitioner, based on previous performance, for the first set of repetitions.

Upon completion of the first set of repetitions, the intensity was maintained or modified if necessary. For example, if the participant was able to only complete four repetitions of a particular exercise indicating the exercise intensity was too high, the exercise was made easier for the second set. These changes allowed for individualized tailoring of each session based on the performance of the participant. This process was repeated for each exercise completed during the session. Participants were not given the exercise completed in the first round as a choice of activity in the second round to ensure variety during each session.

At the end of session, the participant and caregiver were reminded to contact the practitioner if any problems arose between sessions (e.g., pain, scheduling conflicts). The participant and caregiver also were encouraged to use the Participant and Care Partner Information Packet to record any questions prior
to the next session as well as manage any exercise-related muscle soreness that may occur.

**Comparison group.** The comparison group was instructed to continue with “normal daily activities” for the 12-week period. If comparison group participants engaged in regular exercise, they were encouraged to continue these activities. As mentioned earlier, after the follow-up assessment, participants were given resources regarding physical activity and exercise. They also were invited to attend a workshop on physical activity and exercise led by the research team.

**Data collection**

**Assessments.** Baseline (Time 1) data were collected during the baseline assessment for all participants. After obtaining informed consent from the participant and the participant’s care partner, this assessment was conducted by the primary researcher in the participant’s home. This included the completion of the MMSE for study inclusion, the demographic and health information questionnaire, and outcome measures for the primary functional limitation of cognition (TMT-B), secondary functional limitations of leg strength, balance, and gait speed (30-second chair stand, modified Berg Balance Scale, 8-foot walk test), and disability (activities of daily living scale) as completed by IWDs.

Following the completion of the 12-week timeframe, time 2 data were collected in the participant’s home by the principal researcher. The time 2 assessment included outcome measures examining the primary functional limitation of cognition (TMT-B), secondary functional limitations of leg strength,
balance, and gait speed (30-second chair stand, modified Berg Balance Scale, 8-foot walk test), and disability (activities of daily living scale).

**Exercise session logs.** For participants in the intervention group, exercise session logs recorded information regarding treatment adherence, intervention tolerance, exercise intensity, and exercise-practitioner session evaluations (Appendix N). The session logs and attendance information were maintained by the exercise practitioner on an ongoing basis.

**Statistical analysis**

Data were input into SPSS Statistical Software (Version 22.0, IBM Statistics) for analysis. Outlier analyses were completed to determine presence of potential outliers or other missing data issues as well as examine the variability and distribution of the outcome variables. No outliers were found and distributions for all related outcome variables appeared normal. Descriptive statistics were analyzed and compared to known norms to allow for representation of sample in the current study.

Data from the three individuals used for the piloting of the intervention were compared to other participants (both the intervention group and the total sample). Since no significant changes were made to the intervention as a result of the pilot testing, it was appropriate to include these individuals in the analysis if able. No significant differences were identified with respect to baseline statistics between the pilot group and other participants; therefore the data from the pilot group were included with others in the intervention group for acceptability and feasibility as well as efficacy testing.
Baseline statistics between intervention and comparison groups were compared for demographic information and baseline characteristics, as well as for each outcome measure, using mean difference tests to ensure these groups were similar on the set of baseline measures. Table 5 highlights the results of these comparative analyses. Results indicated no significant differences noted (p=.05) between the intervention and comparison groups on any of the demographic or baseline performance measures.

An “as treated approach” was used during analysis as efficacy was being assessed in the current study (Armijo-Olivo, Warren, & Magee, 2009). This approach compares outcomes in participants according to treatment received, which includes anyone in the intervention group receiving more than 80% of the prescribed intervention (Armijo-Olivo et al., 2009). Using the “as treated approach” is most appropriate in the current research design due to the exploratory nature of the study and the goal of measuring the effect of the intervention on those that received the appropriate dosage.

Analyses to answer the research questions of acceptability and feasibility as well as implementation fidelity of this intervention to a sample of IWDs included descriptive statistics. Items included in the analyses of acceptability and feasibility were treatment adherence, intervention tolerance (occurrence of adverse events), and items from the exercise-practitioner session evaluations. These session evaluations were aggregated across all sessions for each participant. Intervention fidelity was analyzed using descriptive statistics to discuss the participant’s ability to perform at the prescribed exercise intensity.
Multiple linear regression analyses were used to test Hypotheses #1 through 5 to determine the efficacy of the intervention on each outcome measure. Each outcome measure (Hypothesis #1: cognitive function (TMT-B); Hypothesis #2: balance (modified Berg Balance Scale); Hypothesis #3: lower-extremity strength (30-second chair stand test); Hypothesis #4: comfortable and fast gait speed (8-foot walk test); and Hypothesis #5: perceived ADL function (ADL scale)) served as the dependent variable. The key independent variable was a dichotomous variable representing assignment into the intervention or comparison group (K. S. Judge, Yarry, Looman, & Bass, 2013; Tabachnick & Fidell, 2007). 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.

**Participant Characteristics**

Of the 27 participants enrolled in the current study, 23 completed a follow-up (Time 2) assessment. Of the four participants that did not complete the follow-up assessment, one participant did not meet study criteria upon completion of the MMSE; therefore no baseline assessment was completed. One participant assigned to the comparison group withdrew prior to the follow-up assessment due to feeling anxious following the baseline assessment. One participant assigned to the intervention group was hospitalized following session 14 (with medical issues unrelated to the exercise program) requiring placement in a skilled nursing facility. The remaining participant, assigned to the intervention group, suffered a cerebrovascular accident (stroke) between
Table 5. Participant Characteristics and Baseline Performance

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

<table>
<thead>
<tr>
<th>%</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>56.5%</td>
<td>46.2%</td>
</tr>
<tr>
<td>College graduate</td>
<td>47.8%</td>
<td>38.5%</td>
</tr>
</tbody>
</table>

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.

Note. No significant differences were noted between groups on demographic or baseline performance variables, p=.05.
sessions 2 and 3; therefore this participant was excluded from continuation in the current study. The remaining 23 participants were included in the statistical analyses.

All of the participants 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 73.86 years ($SD = 9.13$), was 56.5% female, and exhibited mild to moderate level of cognitive impairment (MMSE: $\bar{X} = 20.83; SD = 5.02$) with 12 individuals having Alzheimer’s disease, two having Lewy body dementia, one having frontotemporal dementia, and three having unspecified dementia. The participants averaged 4.04 number of chronic health conditions ($SD = 1.85$) and self-rated their overall health at a 2.17 on a scale of 0=poor to 3=excellent ($SD=0.72$). Participant characteristics along with performance on baseline outcome measures are summarized in Table 5. These are displayed for the total sample as well as for the intervention and comparison groups separately. No statistical differences on any of the participant characteristics or baseline measures were found between intervention group and comparison group participants.
CHAPTER III

RESULTS

In this section, findings related to the research questions regarding acceptability and feasibility as well as intervention fidelity are outlined. These results are followed by findings related to each hypothesis posited regarding the effect of the intervention on outcomes of cognitive function, balance, lower-extremity strength, gait speed, and perceived ADL functioning.

Acceptability and Feasibility

Treatment adherence. The first measure of acceptability and feasibility for the current program was whether the participants were able to complete the 24 sessions of the intervention. Of the 13 participants, there were a total of 312 scheduled exercise sessions. These sessions were divided between the exercise-practitioners fairly evenly with 168 sessions (54%) scheduled with ND and 144 sessions (46%) scheduled with HG. A total of 309 were completed for a total treatment adherence of 99.04%. The three missed visits were by a single
participant requiring medical intervention for symptoms unrelated to the exercise 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 through the monitoring of adverse events. Any adverse events were recorded during each session and defined as “discomfort that manifested itself or became worse because of the exercises” (Littbrand et al., 2006, p. 494). An adverse event was recorded if expressed by the participant or changes in performance were noted by the practitioner. If an adverse event was noted, it was rated as either temporary and minor or serious and major.

Over the course of the current study, 5 minor adverse events were noted during the 309 sessions (1.6%). These included things such as dizziness, back spasm, or headache. All symptoms resolved during the session and the participants were able to continue and complete the session. No major adverse events were experienced by any of the participants during any of the sessions. Additionally, 16 adverse events were noted between sessions with all being minor and temporary events. Reasons for these symptoms between sessions were all related to soreness (delayed onset muscle soreness or specific joint such as hip or knee), which had resolved 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. This rate of adverse events is similar to the rate of 9% reported by Littbrand et al.
(2006) during the HIFE protocol indicating a good tolerance to the moderate-intensity exercise program.

Exercise-practitioner session evaluations. Following each exercise session, the exercise practitioner was asked to complete a series of evaluative questions rating participant engagement, fidelity to the protocol, and the implementation process. Each question was rated on a 4-point Likert scale (0=not at all, 1=some of the time, 2=most of the time, 3=for the entire session). These items rated 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 implementation (feasibility).

The current intervention demonstrated high levels of acceptability and feasibility as evaluated by the exercise practitioners. These ratings were analyzed across all 24 sessions as well as being separated by the acclimation period, which included the first 2 weeks of the program (4 sessions), and the moderate-intensity period, which included the remaining 20 sessions. This was done to determine whether the first 4 sessions not only assisted with exercise tolerance and progression, but also gave the participant time to better understand the protocol. The results from the exercise-practitioner session evaluations are summarized in Table 6.

Results indicated that participants were engaged in the process throughout the intervention program ($\bar{x}=2.87, SD=0.18$). Participants were able to both understand ($\bar{x}=2.89, SD=0.19$) and complete ($\bar{x}=2.87, SD=0.19$) the
Table 6. *Summary of Exercise-Practitioner Session Evaluation (n=13).*

<table>
<thead>
<tr>
<th>During this session, how much did the participant:</th>
<th>Overall (24 sessions)</th>
<th>Acclimation Period (4 sessions)</th>
<th>Moderate-intensity period (20 sessions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>engage in the program</td>
<td>2.87</td>
<td>0.18</td>
<td>2.89</td>
</tr>
<tr>
<td>understand the material and protocol</td>
<td>2.89</td>
<td>0.19</td>
<td>2.73</td>
</tr>
<tr>
<td>complete the protocol without additional instruction using physical cues or assistance</td>
<td>2.87</td>
<td>0.19</td>
<td>2.60</td>
</tr>
<tr>
<td>perform at the prescribed intensity</td>
<td>2.97</td>
<td>0.07</td>
<td>2.96</td>
</tr>
<tr>
<td>get frustrated by the protocol</td>
<td>0.02</td>
<td>0.05</td>
<td>0.04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During this session, how much did you (exercise-practitioner):</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>feel that you adequately addressed the questions and concerns of the dyad</td>
<td>3.00</td>
<td>0.01</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
<td>0.14</td>
</tr>
<tr>
<td>adhere to the protocol</td>
<td>2.86</td>
<td>0.24</td>
<td>2.67</td>
<td>0.58</td>
<td>2.91</td>
<td>0.17</td>
</tr>
<tr>
<td>enjoy leading the session</td>
<td>2.93</td>
<td>0.11</td>
<td>2.88</td>
<td>0.19</td>
<td>2.94</td>
<td>0.10</td>
</tr>
<tr>
<td>feel confident in ability to deliver program effectively</td>
<td>2.99</td>
<td>0.12</td>
<td>2.96</td>
<td>0.09</td>
<td>3.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

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

Protocol as delivered. It appears as though the acclimation period served as it should have with scores on these items being slightly lowered in the first 4 sessions (the acclimation period) when compared to the remainder of the program. Per the exercise-practitioner reports, participants were able to complete the exercises at the prescribed intensity ($\bar{X}=2.97$, $SD=0.07$) equally
throughout the program and did not appear frustrated during the process \((\bar{x} = 0.02, \text{SD} = 0.05)\).

The exercise practitioners felt confident in delivering the program efficiently \((\bar{x} = 2.99, \text{SD} = 0.12)\) as well as addressing the questions and concerns of the participant and their caregiver \((\bar{x} = 3.00, \text{SD} = 0.01)\). Good adherence to the protocol was maintained throughout each session throughout implementation \((\bar{x} = 2.86, \text{SD} = 0.24)\); however, the exercise-practitioner demonstrated a slight improvement with protocol adherence following the acclimation period. Generally, a high level of enjoyment was reported by the practitioner throughout the intervention period \((\bar{x} = 2.93, \text{SD} = 0.11)\).

In addition to these survey results, participants were asked after the final session “how much did you enjoy the program?” Response categories, which were shown to the participants in written form, included “not at all”, “a little bit”, “it was okay”, or “loved it, it was great”. Twelve out of the 13 participants (92.3%) endorsed “loved it, it was great”, while the other participant said, “it was okay”. This high level of verbal endorsement is supported by the treatment adherence in the program and indicates that the participants enjoyed participating in the moderate-intensity functional strength and balance program.

**Intervention Fidelity**

Fidelity to the protocol was first examined by assessing the congruence of assigned Physical Function Group to the exercise categories used in each session. For example, if a participant was assigned to Physical Function Group 2, the exercise practitioner should have chosen from exercise categories A, B, or
which was indicated on each session’s log. Of the 13 participants assigned to the intervention group, 12 were placed in Physical Function Group 1, one was placed in Physical Function Group 2, and none were placed in Physical Function Group 3 at the beginning of the intervention period. These Physical Function Groups guided the exercise practitioner in which exercise categories to use during each session.

Over 94% (294) of all sessions were completed within the prescribed exercise categories based on their assigned Physical Function Group (see Table 3) indicating a high level of fidelity to the protocol. This is important as the protocol allows for an individualized exercise prescription based on the participant’s starting level of physical function. For example, if an individual was assigned to Physical Function Group 1 (the highest functional category), the exercise choices should have been made from categories A and B. It should be noted that only a single participant required modification. This participant was able to progress to a congruent match of Physical Function Group and exercise categories by the end of the intervention. Initial modification, including less dynamic activities, was required due to motor control and planning difficulties; therefore, in order to achieve the appropriate level of intensity, some lower level exercises were needed.

In addition to assessing the congruence of Physical Function Group and exercise categories, the protocol calls for moderate-intensity exercise. Following the 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, beginning in week 3, 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. This indicates that exercises, on average, were completed at the prescribed level of intensity.

**Efficacy Testing**

To examine efficacy of the intervention, separate multiple regression analysis were conducted for each outcome (see Table 7 for a summary of these results). Assignment in intervention or comparison was the key predictor variable in the regression equation. The baseline performance variable corresponding to the appropriate dependent variable was included to allow for appraisal of change in performance during the 12-week period. Additionally, to examine the potential impact of current level of exercise, this covariate was included in the analysis but was later removed due to the insignificance found on all outcomes. Finally, in attempts to better understand perceived ADL function, analyses were conducted using subscales of instrumental ADLs (e.g., financial management, meal preparation, driving) and personal ADLs (e.g., bathing, dressing, transfers). However, no difference was noted compared to using the scale as a single measure or as subscales; therefore, only the full scale results will be reported.

In order to provide a better understanding for the clinical implications of the findings, the baseline and follow-up mean values of the significant outcome measures have been graphed (Figure 3). While the unstandardized regression coefficients provide understanding of the magnitude of the intervention’s effect, it may be helpful to clarify this value to provide a better clinical picture. A graphical
representation of the baseline and follow-up means for each group compliment the regression coefficients to provide a better illustration of the movement demonstrated in the outcome measures.

**Hypothesis #1 (cognitive function).** It was hypothesized that participants in the intervention would demonstrate significant improvement in executive function as measured by the TMT-B. 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 ($t=0.55, p=.59$).

**Hypothesis #2 (balance).** It was hypothesized that participants in the intervention would demonstrate significant improvement in balance scores as measured by the modified Berg Balance Scale. Significant results were found supporting hypothesis 2, with participants in the intervention group demonstrating improved balance compared to comparison group participants. Unstandardized regression coefficients show an average of 4.04 points better for the intervention group on the m-BBS at Time 2 ($t=4.13, p=.001$) than the comparison group.

To further visualize the difference in performance by the two groups, baseline and follow-up mean performance for each group was graphed. This is represented in Figure 3a, illustrating the unstandardized regression coefficient includes both an improvement in the intervention group as well as a decline in the comparison group over the 12-week period.

**Hypothesis #3 (lower-extremity strength).** It was hypothesized that participants in the intervention would demonstrate significant improvement in

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Table 7. Regression Analysis for Predicting Outcome Variables (N=23).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>TMT-B (cognition)</th>
<th>m-BBS (balance)</th>
<th>Chair stand (leg strength)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>β</td>
<td>B</td>
</tr>
<tr>
<td>Assigned group</td>
<td>34.41</td>
<td>0.10</td>
<td>4.04*</td>
</tr>
<tr>
<td>Baseline performance</td>
<td>0.84*</td>
<td>0.70*</td>
<td>0.94</td>
</tr>
</tbody>
</table>

*p≤.001; **p≤.01; ***p≤.05

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Comfortable gait speed</th>
<th>Fast gait speed</th>
<th>ADL scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>β</td>
<td>B</td>
</tr>
<tr>
<td>Assigned group</td>
<td>0.01</td>
<td>0.18</td>
<td>0.32***</td>
</tr>
<tr>
<td>Baseline performance</td>
<td>0.72*</td>
<td>0.76*</td>
<td>0.77*</td>
</tr>
</tbody>
</table>

*p≤.001; **p≤.01; ***p≤.05.

lower-extremity strength as measured by the 30-second Chair Stand test.

Results indicated that assignment to the intervention group predicted significantly higher performance during the follow-up assessment (t=3.26, p=.004) as compared to comparison group participants. Unstandardized regression coefficients show an average of 5.92 more repetitions completed in 30 seconds in the intervention group than the comparison group, which supports the stated hypothesis.

To further visualize the performance at baseline and follow-up, mean values on the 30-second Chair Stand test for each group was graphed. This is
represented in Figure 3b, illustrating the unstandardized regression coefficient includes both an improvement in the intervention group as well as a decline in the comparison group over the 12-week period.

**Hypothesis #4 (gait speed).** It was hypothesized that participants in the intervention would demonstrate significant improvement in both comfortable and fast gait speed as measured by the 8-foot Walk test. Partial support was found for this hypothesis in the current study. 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 ($t=2.61$, $p=.02$) compared to comparison group participants. Unstandardized regression coefficients show an average of 0.32 meters per second difference was found in fast gait speed for intervention group participants when compared to comparison group participants.

To further visualize the difference in performance by the two groups, baseline and follow-up mean performance on fast gait speed for each group were graphed. This is represented in Figure 3c, illustrating the unstandardized regression coefficient is driven primarily by an improvement in the intervention group over the 12-week period.

**Hypothesis #5 (perceived ADL function).** The current study predicted that participants in the exercise program would report significantly less difficulty during activities of daily living when compared to participants in the comparison group. Results did not support this hypothesis. Assignment to the intervention or
comparison group did not significantly predict perceived performance on ADL functioning at Time 2 ($t=-.94, p=.36$).

Table 8. Baseline and Follow-up Performance for Each Group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Time 1 mean</th>
<th>Time 2 mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMT-B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>4:27 (2:01)</td>
<td>7:42 (5:35)</td>
</tr>
<tr>
<td>C</td>
<td>4:44 (2:57)</td>
<td>5:51 (3:12)</td>
</tr>
<tr>
<td>m-BBS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>39.46 (3.31)</td>
<td>41.54 (2.18)</td>
</tr>
<tr>
<td>C</td>
<td>38.50 (8.03)</td>
<td>36.60 (8.68)</td>
</tr>
<tr>
<td>Chair Stand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>14.00 (5.82)</td>
<td>17.85 (6.83)</td>
</tr>
<tr>
<td>C</td>
<td>15.70 (6.08)</td>
<td>13.20 (4.92)</td>
</tr>
<tr>
<td>Gait Speed (comfortable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.69 (0.18)</td>
<td>0.67 (0.13)</td>
</tr>
<tr>
<td>C</td>
<td>0.65 (0.24)</td>
<td>0.63 (0.27)</td>
</tr>
<tr>
<td>Gait Speed (fast)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>1.24 (0.27)</td>
<td>1.58 (0.33)</td>
</tr>
<tr>
<td>C</td>
<td>1.35 (0.62)</td>
<td>1.34 (0.57)</td>
</tr>
<tr>
<td>ADL Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>7.25 (5.13)</td>
<td>6.83 (5.13)</td>
</tr>
<tr>
<td>C</td>
<td>4.20 (3.85)</td>
<td>5.40 (6.72)</td>
</tr>
</tbody>
</table>

Figure 3. Graphic Representation of Baseline and Follow-up Performance on Outcome Measures for Each Group.

Figure 3a. Baseline and Follow-Up Means for mBBS for Each Group.

<table>
<thead>
<tr>
<th></th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>m-BBS (maximum 44)</td>
<td>39.46</td>
<td>41.54</td>
</tr>
<tr>
<td></td>
<td>38.5</td>
<td>36.6</td>
</tr>
</tbody>
</table>

Intervention | Comparison

Figure 3b. Baseline and Follow-Up Means for 30-Second Chair Stand Test for Each Group.

<table>
<thead>
<tr>
<th></th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-second Chair Stand (repetitions)</td>
<td>15.7</td>
<td>17.85</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>13.2</td>
</tr>
</tbody>
</table>

Intervention | Comparison
Figure 3c. Baseline and Follow-Up Means for Fast Gait Speed for Each Group.

Gait Speed (fast, m/s)

<table>
<thead>
<tr>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.24</td>
<td>1.58</td>
</tr>
<tr>
<td>1.34</td>
<td></td>
</tr>
</tbody>
</table>

Intervention | Comparison
CHAPTER IV

DISCUSSION

The current study assessed the acceptability and feasibility of implementing a moderate-intensity home-based functional exercise program using a sample of community-dwelling IWDs. Additionally, the study examined the efficacy of this intervention on cognitive and functional performance in these individuals. High levels of acceptability and feasibility as well as protocol fidelity were found along with positive effects on lower-extremity strength, balance, and fast gait speed. These findings along with key implications are discussed further.

Acceptability and Feasibility

Examining the acceptability and feasibility of any newly developed intervention is essential to determine whether the protocol needs modification. The current moderate-intensity exercise program was found to be highly acceptable and feasible increasing support that IWDs can participate and engage in this type of program. The intervention was well tolerated by participants, had
an extremely high level of treatment adherence, and good fidelity to the moderate-intensity exercise level. Tolerance to the current intervention, as measured by a 6.7% adverse event rate, was slightly better than the HIFE protocol, which reported adverse events in 9% of total sessions (Littbrand et al., 2006). It may be that Littbrand et al. (2006) had a slightly higher occurrence of these events due to sample differences. Littbrand et al. (2006) studied a population of nursing home residents, which may have been more vulnerable than the relatively healthy, community-dwelling adults in the current study. Additionally, the current study used a one-on-one approach, which may have allowed better supervision and individualization than a small group setting as used in the HIFE protocol.

The attendance rate in the current study was extremely high at 99% and compared to similar programs was found to be higher as well. For example, a study that implemented a strength and balance outpatient program demonstrated an 85% attendance rate over 3 months (Hauer et al., 2012). Other studies examining moderate-intensity exercise had adherence rates of 72% (Littbrand et al., 2006; Rosendahl et al., 2006), 33.2% (Rolland et al., 2007), and 70% (Netz et al., 2007). Treatment adherence or attendance rate is an important component of acceptability as well as fidelity as it measures program exposure, which is related to the structure of the intervention (Fraser & Galinsky, 2010; Fraser et al., 2009).

This measurement of program exposure is crucial to being able to determine the dose of the intervention in which the participant received. This
dosage must be quantified in order to truly assess its efficacy. For example, if a patient only takes an antibiotic three out of the prescribed 10-day regimen and finds no benefit, a physician is not able to determine if the medication needs changed. The patient must completed the entire 10-day dose prior to determining whether a more potent or different medication is needed. Similarly, if only 60% of the exercise sessions were completed with no improvement, it is difficult to determine whether different exercise are needed. It may be possible that if the individual completed 100% of the exercise sessions improvement would be noted.

Several key factors could have played a role in the high levels of treatment adherence found in the current study. The design of the intervention was made to be flexible for the participant and the caregiver; therefore scheduling accommodated the participant as much as possible. If a session needed be changed due to conflicts, the exercise practitioner was able to adjust the schedule as needed.

Motivators for physical activity in older adults include purposeful activity, accessibility, and programming (Costello et al., 2011). The current intervention included functional strengthening exercises that mimic everyday activities to allow the individual to better understand the purpose of each exercise. This type of exercise is more pragmatic for the needs of IWDs as it relies on procedural memory rather than unfamiliar tasks. Additionally, the intervention was delivered in the home allowing the most optimal accessibility, especially during the brutal winter months of Northeast Ohio. Participants and caregivers did not have to
travel to an outside location, which may include finding parking or driving in traffic.

Principles from the Strength-Based Approach also maximized implementation by taking in consideration the specialized needs of IWDs. The intervention was designed to provide a standard structure to the protocol (universal design), but provided the exercise practitioner with enough flexibility to tailor each session to the individual’s needs. For example, the protocol included always demonstrating each exercise for the participant building on their ability to model behavior. It included functional exercises that relied heavily on the IWDs’ remaining procedural memory. Each participant was given the ability to choose from two exercises, which follows the principle of including individuals as active rather than passive participants. Anecdotally, many participants would occasionally identify particular activities that “they did not like” or “were scared to try”, therefore they would be able to choose the alternate option. If the practitioner was not aware of these likes and dislikes or concerns due to the participant’s silence, it is likely that the participant would have been asked to regularly complete activities that they did not enjoy or were afraid to complete. This could have led to anxiety, which may have reduced enjoyment and adherence to the program.

In addition to the structure of the program, the process or implementation must be examined. In the current study, exercise intensity partially measured this component of fidelity. With participants completing an average of 11.67 repetition maximum during the strength portion of the program along with an
average of 59.98 seconds of balance activities, fidelity to the intended protocol was maintained over the course of the intervention. The goal for the intervention, following the 2-week acclimation phase, was for participants to complete 8RM to 12RM for the strength exercises and one minute of each of the balance activities. This supports research that older adults can participate in and benefit from exercise at a moderate-intensity level (Baker et al., 2010; Hauer et al., 2012; Littbrand et al., 2006; Rosendahl et al., 2006).

At this level of moderate-intensity, the rate of 6.7% adverse events (e.g., muscle soreness, joint pain) is taken as evidence of the acceptability of the intervention protocol specifically the level of intensity for the exercises (Littbrand et al., 2006). Overall, the current sample was comprised of relatively healthy, community-dwelling older adults. In addition, trained exercise professionals with specialized training in working with the older adult population closely supervised the exercises. Despite minimal challenges with soreness or discomfort, participants were rated by the exercise-practitioner as being very engaged in the program and demonstrating a good understanding of the exercises and protocol. No significant frustration was exhibited by the IWDs during the program. The exercise-practitioners endorsed high levels of confidence and enjoyment while implementing the intervention with the participants. These high levels of acceptability and feasibility on the part of the IWDs and exercise-practitioner most likely contributed to the excellent treatment adherence and program fidelity.
Efficacy

The exercise program demonstrated efficacious effects on the secondary functional limitations of 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.

These findings support previous literature linking exercise to improvements in physical performance in IWDs. A progressive resistance and functional training program resulted in improved scores on functional performance tests including the chair stand test and fast gait speed (Hauer et al., 2012). Also, improvements in chair transfers were noted following a progressive strengthening program over a 16-week period (Roach et al., 2011). Netz et al. (2007) noted significant functional gains in walking performance only when the intensity of the program was increased in its final phase of implementation. Finally, improved balance and lower extremity strength were found following implementation of the HIFE protocol with a sample of nursing home residents (Rosendahl et al., 2006). One important feature shared by these studies is a progressive exercise program that challenges the participants as suggested by the Physical Stress Theory (Mueller & Maluf, 2002). The current intervention included a progressive resistance program that was tailored to the individual needs of the participant each session. The baseline assessment allowed for an
appropriate starting point for each individual while continuous monitoring of performance each session was maintained by the exercise practitioner. If the individual's level of intensity needed adjusted, it modified appropriately during the next set of the activity.

While strength, balance, and fast gait speed demonstrated significant improvements, there was no efficacy identified in the primary functional limitation of cognitive function, secondary functional limitation of comfortable gait speed, or the disability measure of perceived ADL function. These findings do not support previous literature. Significant improvements in cognitive function were found through changes in performance on the TMT-B following a high-intensity exercise program (Baker et al., 2010). Kemoun et al. (2010) found improvements in cognitive function for a group of nursing home residents following a 15-week multi-component exercise program. A potentially important difference exists between these programs and the current intervention, which could possibly account for the mixed results. Both previously mentioned interventions contain moderate- to high-intensity aerobic training.

While it has been identified that strength training can induce hormonal adaptations (IGF-1 and BDNP) that are neuroprotective (Ahlskog et al., 2011), Kramer et al. (2005) report that best results have been found with a combination of strength training and aerobic activity. Additionally, voluntary running, which is considered a moderate- to high-intensity aerobic activity in most individuals, has been linked to increases in BDNF (Stranahan, Zhou, Martin, & Maudsley, 2009). Therefore, it is possible that addition of a moderate- to high-intensity aerobic
activity (e.g., running, playing tennis, biking, gardening) to the current intervention may be required to elicit adaptive changes in the neural tissue required for improvements in executive function. Figure 4 proposes possible relationships between different modes of exercises to health-related outcomes based upon previous literature presented in this paper. These relationships may play a crucial role in intervention development as well as proper alignment of exercise components and intended outcomes. For example, aggregating previous literature leads one to believe that to most effectively intervene upon all three domains of cognition, function, and well-being through exercise, the intervention should include strength training, balance activities, and aerobic exercise. But if the intended outcome is only functional measures, strength training and balance activities should be sufficient to elicit these effects. Additionally, one must understand the complex relationship that exists between the outcome variables. For example, increased levels of depression may lead to decrease cognitive function (Insel & Badger, 2002). Also, as mentioned earlier, there is an important relationship between cognition and ADL performance; therefore, if an individual is displaying difficulties in ADL function, it may be due to strength and balance as well as reduce executive function.

Another possible explanation for the difference in findings may be that the sample of participants used by Baker et al. (2010) displayed mild cognitive impairment with a MMSE score of approximately 27 out of 30, whereas the sample in the current study had lower cognitive performance with an average MMSE score of 21 indicating mild to moderate impairment. The participants in
the current study took an average of 4 minutes and 36 seconds to complete the TMT-B test. When compared to normative data for community-dwelling older adults of 86.27 seconds, this demonstrates the participants in the current study began with a high level of executive dysfunction. While Baker et al. (2010) did not report average performance on this measure, making it difficult to compare to the current sample, it is possible that a simpler test of executive function, such as the Flanker Task (Luks et al., 2010), may have been appropriate to use with a clinical sample of individuals. Few assessment tools are available to applied
researchers that have been tested with IWDs with mild to moderate cognitive impairment that demonstrate the appropriate level of sensitivity needed to observe effects of this type of intervention. More studies are needed to identify valid and reliable tools for use in this line of research.

Improvements were reported on the Katz ADL scale by Santana-Sosa et al. (2008) upon completion of a 12-week strength and balance program. The current study did not find support for these results; however, it did support the findings by Rolland et al. (2007) in which no significant change occurred in ADL function. It should be noted, however, that in that study only treatment adherence was only 33.2% on average with a very wide variance (Rolland et al., 2007). In trying to understand the mixed findings with Santana-Sosa et al. (2008) several key differences exist and should be noted. First, the scale only included the PADL items of the ADL scale looking at items such as bathing, dressing, toileting, and transfers whereas the current study included both IADL and PADL items. In the current study, the items did not reliability separate into subscales; therefore it is difficult to completely compare the results. Next, the sample of IWDs used in that study lived in a residential care facility, therefore it is likely they were more impaired than the current sample. Finally, the protocol used in the Santana-Sosa et al. (2008) study included progressive resistance training for both the upper and lower extremities which may have influenced the effect of exercise on ADL activity. Finally, it is unclear from the protocol in the previous studies whether the measures of ADL were reported by the IWD, proxy-reported by a care provider, or directly observed by the researcher. While all methods
measure disability and are extremely important outcome measures, an exercise intervention may have differential effects on perceived ADL function and observed ADL function. Other ADL assessments may provide further in-depth information regarding the functional process and potentially better understand the underlying mechanisms (e.g., executive function, motoric function) of these complex tasks. Some potential assessment tools could include the Assessment of Motor and Process Skills (Fisher & Jones, 1999), the Independent Living Scales (Loeb, 1996), and the Performance Assessment of Self Care Skills (Holm, Rogers, & Hemphill-Pearson, 2008).

The current study was most interested in perceived ADL function from the perspective of the IWD. As mentioned earlier, Verbrugge and Jette (1994, p. 5) state that “subjective [items] reveal the experience of disability in apt and direct manner”. The current study included assessment tools to assess the interventions direct effect on functional limitations such as strength and balance, which were objectively measured. The ADL scale was meant to better understand the intervention’s effect on the illness experience, therefore the self-report method was crucial to gathering this information. It is apparent that while the intervention did directly affect the objective measures of lower-extremity strength, balance, and fast gait speed, the perceived ADL function did not significantly change through the intervention.

Other possible considerations for these non-significant findings with respects to perceived ADL function should be discussed. With the high levels of physical function in the current sample, most difficulty was likely found in
completion of instrumental activities of daily living, such as finances and medication management, rather than the simpler tasks like bathing and dressing. Improvements in strength, balance, and fast gait speed should conceptually have a larger influence on these simpler and lower level tasks due to the nature of the activity, whereas the IADL activities are comprised of more cognitive abilities. Since there was no significant improvement noted in cognitive function, as measured by the TMT-B, in the current study, it is possible that this was necessary for improvements on the ADL scale. Additionally, it is possible that perceived ADL function is too distal of an outcome to observe improvements in a 12-week period. The Disablement Process (Figure 1) outlines that impairments and functional limitations may lead to disability. It is possible that the improvements in strength, balance, and fast gait speed (functional limitations) were not given sufficient time to reduce the level of disability perceived by the participants. However, one might argue that given The Disablement Process, the intervention should be able to independently affect disability rather than moderate or mediate through impairments and functional limitations. Perhaps modifications should be considered to the intervention itself.

While the current intervention has different components or modes of exercise (strength and balance), a more diverse multi-component intervention may be necessary to affect this outcome of perceived ADL function. For example, while no significant changes were noted in the objective measures of physical function (e.g., gait speed, balance), Teri et al. (2003) found that RDAD, a dyadic multi-component intervention with exercise and behavioral management
techniques, did significantly improve scores on the physical functioning subscale of the SF-36 as reported by the caregiver. Items included on this scale included activities such as lifting or carrying groceries, walking several blocks, bathing and dressing, and negotiating stairs. This is slightly different than in the current study as it is a proxy-report; however it does raise the possibility of requiring psychosocial components to intervene in a more holistic approach to truly affect the illness or disability experience.

Additionally, Judge and colleagues found significant improvements in perceived distress in ADL function following a dyadic intervention (Project ANSWERS) including cognitive rehabilitation and skills training for IWDs and their CGs (K. Judge, Yarry, Looman, & Orsulic-Jeras, 2009; K. S. Judge, Menne, & Whitlatch, 2010). Project ANSWERS did not incorporate any type of physical activity or exercise but was able to demonstrate improvements in perceived distress in ADL function after only six sessions. Incorporating both physical and psychosocial components, possibly through an inter-disciplinary approach with clinicians from both the psychological sciences as well as the health sciences, may be best to affect both objective and subjective function. If able to positively affect across these domains, one may suggest alterations in the cycle of dependency and frailty in this sample of older adults. This could lead to increased functional independence, decreased healthcare costs, reduced falls, and less frequency of institutionalization.

Finally, with the current intervention being intended to intervene on functional limitations and disability as an extra-individual factor, it is possible that
other intra- and extra-individual factors, such as coping strategies and social support, are important in determining how a pathology such as dementia will manifest through the illness or disability experience. Even with the mixed findings, the current study provides support for using this type of model (i.e., The Disablement Process) to better understand the effects of an intervention on various outcome measures. More research based on the previous discussion is needed to better understand this complex relationship between variables.

Using this model in future research can be beneficial to allow researchers and clinicians to compare findings as well as identify outcomes relevant to the population. In the current area of study, outcomes such as institutionalization, dependence on caregivers, and continuation of leisure activities may be important as well as psychosocial and well-being outcomes such as depression, anxiety, and quality of life.

**Clinical Implications**

The successful implementation of the current intervention indicates that the Strength-Based Approach is likely appropriate to use not only in the social work and counseling settings; but may be transferred to improve compliance and adherence to physical activity, exercise, and possibly physical rehabilitation such as physical or occupational therapy. It has been reported that participation in rehabilitation has 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. 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.

Patients with dementia pose unique challenges to rehabilitation professionals. Severe deficits in attention, judgment, memory, communication, and language are common in individuals with dementia. However, using a Strength-Based Approach as in the current intervention, remaining strengths can be exploited to optimize participation in rehabilitative services. One of the most powerful cognitive processes available is procedural memory (Beaunieux et al., 2012; Lezak, 2004; Machado et al., 2009; Mahendra et al., 2011). The current intervention, which is an exercise intervention, relies heavily on procedural memory through functional strength and balance activities that could be completed by the IWD sample. Therefore, integration of these techniques into mainstream rehabilitative practice should be feasible for clinicians with this patient population.

Older adults with dementia are 9 times as likely to require a stay in a skilled nursing facility as their cognitively intact counterparts, while per person Medicare payments for an older person with dementia average nearly 3 times higher than those without these conditions (Alzheimer's Association, 2012). In 2012, the direct care cost for adults in the U.S. with Alzheimer's will total an estimated $200 billion, including $140 billion in costs to Medicare and Medicaid (Alzheimer's Association, 2012). If researchers and clinicians would be able to maintain a functional level of lower-extremity strength and balance in these
individuals, it is possible that some of these costs could be abated. Previous research has identified gait speed as an important factor in the prediction of falls in IWDs as well as with transfer from assisting living to a skilled nursing facility (Camicioli & Licis, 2004; Kenny et al., 2008).

Additionally, this line of research highlights the need for various disciplines to engage in inter-disciplinary cooperation. The importance of engaging in psychologically-informed practice in the rehabilitative sciences is becoming more evident (Main & George, 2011). The Disablement Process clearly identifies that the path between pathology and disability can take multiple directions and trajectories; thereby emphasizing the importance for undertaking a lifespan perspective when studying the illness and disability experience (Baltes & Danish, 1980). Having a team of researchers may be helpful in carefully considering these perspectives when attempting to disentangle such a complex process.

Another important clinical implication of the current study is that participants demonstrated a good 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. This is noteworthy because some assumptions exist in adult development and aging research. Many people equate aging with unconditional physical and cognitive decline, which can have consequences with broad application (Golub & Langer, 2007). One of these consequences is the creation of a suboptimal care environment, which could be why many previous studies use such a low intensity
of exercise. There may be a belief that older adults are unable to tolerate activity at higher levels. There may be a belief that age equals frailty; 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. Physicians have been observed to offer less aggressive treatment to older patients (Giugliano et al., 1998). This is quite dangerous in the rehabilitation professions as the patients rely on these clinicians to provide a service that will adequately promote successful outcomes.

It is imperative for researchers and clinicians to ensure that an exercise intervention is being implemented properly to optimize the benefit for the individuals. Evidence-based practice calls for adherence to principles based in research and science. The Physical Stress Theory (Mueller & Maluf, 2002) is one of the guiding principles in exercise prescription and implementation. It states that overload is required to induce beneficial adaptations in muscle and neurological tissue producing improvements in strength and balance. Injury will only occur if the tissues are stressed above maximal ability. Maintaining a moderate-intensity (60-80% of maximum) will lead to positive effects along with good tolerance as demonstrated in the current study. Due to some of these suboptimal care environments, overload thresholds are rarely being reached.

Limitations

There are some limitations in the current study that should be considered. The current sample was recruited with assistance from a local chapter of the Alzheimer's Association, which introduces a recruitment bias. While a large
emphasis of the study was on internal validity and efficacy, it is possible that treatment adherence and fidelity findings may have been different with a more diverse sample of participants. For example, the adherence to the intervention may not be as high with a sample of individuals that are not active with a social service organization such as the Alzheimer’s Association. This might include individuals recruited from a home health agency or physician’s office. However, the universal design of the intervention is intended to maximize adherence through use of purposeful activity, optimizing accessibility, and individualized tailoring of each program (Costello et al., 2011). Recruitment bias is a significant challenge across intervention research in general, but is more crucial in the later phases of intervention research that examine effectiveness and move toward dissemination and larger scale translation. This challenge needs to be overcome with a recruitment process that result in a diverse sample. Future research should explore using recruitment methods that partner with hospital systems, home health care organizations, and physician groups.

Additionally, the current sample was fairly high functioning as 92% were placed in the highest Physical Function Group. It is possible that these individuals were more engaged in the program because of the ability to move around more easily. With that said, the current protocol does involve multiple tiers of exercise categories that is designed to accommodate all functional levels. While the lowest level of exercises were not tested in the current study, these higher level individuals benefited from the higher tiers. Most studies have difficulty engaging the highest level individuals because the exercises are of too
low-intensity; therefore, having success with the highest functioning individuals may be more difficult for an exercise intervention as those individuals do not have as much room to progress.

Another limitation in the current study is the use of a comparison group rather than a true control group. The use of individuals receiving a low-intensity exercise program of the same frequency and duration may be best to control for variables, other than the intervention, that may impact performance.

Finally, neither the researcher nor the participants were blinded to group assignment. However, in the current study, attempts to minimize this bias were made. There was random assignment to the comparison or intervention group and participants in the intervention group were evenly split between exercise practitioners. Additionally, the principal researcher was blinded to the baseline performance of the participant at time of the follow-up. The assessment tools used were fairly objective and straight-forward (e.g., time via stopwatch, repetitions completed) in attempts to limit the subjectivity of the assessor. In further research, it would be ideal for the researcher completing the baseline and follow-up assessments to be blinded of group assignment as well to remove all potential for these measurement biases.

**Future Directions of Research**

Based on the findings from this study, these are several extensions of research that may be considered, including methods attempting to overcome stated limitations. One of the next steps includes replication of the current protocol with a larger sample size. A larger sample size would potentially allow
different comparisons that the current sample could not accommodate due to sample size. For example, stratifying the sample by gender or dementia type may yield interesting findings regarding the variable effects of exercise on different groups of IWDs. Hopefully, more rigorous recruitment procedures allow for heterogeneity in the sample as well, which will begin to address effectiveness and generalizability issues.

Another important consideration in future research is the inclusion of a control group that more closely resembles the structure and function of the intervention. This may include a low-intensity exercise group for the same frequency and duration as the intervention protocol.

Also, inclusion of well-being outcomes may give a better holistic indication of how exercise affects the illness or disability experience in IWDs. Assessing symptoms of depression and anxiety as well as quality of life indicators may allow researchers and clinicians to better understand the association between cognitive and physical function, exercise, and overall well-being. In addition, according to The Disablement Process (Verbrugge & Jette, 1994), several intra- and extra-individual factors that may potentially modify the effects of exercise on these outcomes can be measured at baseline allowing control during analyses. These factors may include exercise efficacy, social support, or previous rehabilitative exposure. Inclusion of these factors would allow researchers and clinicians to appreciate how different variables may alter the course of intervention. Another potential moderating factor that may prove important in the performance of older adults, particularly IWDs, is processing speed. This can be
measured through a simple reaction test and may provide baseline information regarding the general neurological condition of the individual.

Modifications to the intervention may be considered in future research. It may be necessary to add an aerobic component to the intervention in order to demonstrate improvements in cognitive outcomes (Figure 4). This would bring significant changes to the implementation of the intervention and likely warrant increased participation from the caregiver to monitor completion of daily aerobic exercise. However, with daily session logs and tightly scripted instructions, it is a feasible addition in future. Addition of cognitive rehabilitative skills or behavioral management training may be introduced to determine affects of this holistic multi-component intervention on the illness and disability experience.

Along with increased participation of the caregiver in this modification, future research could determine how exercise with the IWD affects the caregiver. While including the caregiver in the intervention may increase a time commitment in a potentially already busy schedule, it is possible that the benefits would outweigh the investment. For example, it is possible that improving balance, strength, and gait speed in the IWD would reduce caregiver strain or burden as the IWD is more mobile. In addition, it is possible that due to energy expended during the intervention may reduce observed neuropsychiatric behaviors, improve sleep, and increase engagement in other aspects of care. All of these factors can affect the IWD, caregiver, or dyad as a unit. Gaining a better understanding of these factors and how exercise affects them could certainly provide insight into the illness and disability experience.
Also, the current study used highly trained exercise-practitioners to implement the protocol. It would be interesting to determine if the same level of outcomes could be achieved with less skilled individuals (e.g., home health aides, Alzheimer’s Association staff members) or if the skill of practitioners (e.g., Physical Therapists, ACSM fitness specialists) is needed to achieve efficacious outcomes. This is important in order to determine the level of sustainability and potential funding sources for programmatic implementation. For example, if staff from the Alzheimer’s Association, which is a non-profit organization, can provide the services then it may be readily available for individuals being served by the organization. If a trained exercise specialist must implement the intervention to ensure efficacy, then it may be that a more formal referral is needed to the program. Most likely, Physical Therapists would need to be recruited and trained in the protocol so that Medicare or similar insurance funders would provide reimbursement for the services in efforts to avoid a private, cash fee-for-service environment.

The implementation also could be modified for a group setting for implementation in an adult day program or assisted living environment. Additional tiers of exercise could be added to allow inclusion of non-ambulatory individuals as appropriate. In the current study, exclusion criteria existed which precluded individuals with certain neurological or musculoskeletal disorders from participation. Future research could include these individuals to improve translation and extend generalizability for rehabilitative purposes.
Finally, future studies would be beneficial in order to ascertain the long-term effects of the exercise intervention in IWDs. Areas of interest may include continued adherence to regular physical activity following completion of the protocol as well as maintenance of gains made during the program. Longer-term studies also would allow researchers to better study the effects of the intervention on The Disablement Process. For example, identifying the relationships between intervention (extra-individual factor) to proximal and distal outcomes, such as gait speed (functional limitation) and perceived ADL function (disability).
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impairment on rehabilitation participation and recovery from hip fracture.


Appendix A. Demographic and Health Questionnaire

Participant ID ___________________________ Date ______________________

What is your date of birth? _____/_____/_____

MO  DAY  YEAR

What is your gender? 1 FEMALE  2 MALE

What is your marital status? 1 SINGLE  2 MARRIED  3 WIDOWED  4 OTHER

What is your relationship to (NAME OF CAREGIVER)?

1 SPOUSE
2 CHILD
3 SON/DAUGHTER-IN-LAW
4 SIBLING
5 GRANDCHILD
6 GRANDCHILD-IN-LAW
7 PARENT
8 GRANDPARENT
9 OTHER RELATIVE: _______________________
10 FRIEND
11 NEIGHBOR
12 OTHER: _______________________

What racial group do you belong to?

1 WHITE, NOT OF HISPANIC ORIGIN
2 ASIAN OR PACIFIC ISLANDER
3 BLACK, NOT OF HISPANIC ORIGIN
4 HISPANIC
5 AMERICAN INDIAN OR ALASKAN NATIVE
6 OTHER: _______________________
7 OTHER:

How much education have you completed?

1 NEVER ATTENDED SCHOOL
2 8TH GRADE OR LESS
3 ATTENDED HIGH SCHOOL – DID NOT GRADUATE
4 COMPLETED HIGH SCHOOL
5 VOCATIONAL TRAINING AFTER HIGH SCHOOL
6 SOME COLLEGE
7 COLLEGE GRADUATE
8 GRADUATE DEGREE
How would you rate your overall health?  0 POOR  1 FAIR  2 GOOD  3 EXCELLENT

Do you currently have any of these ongoing or chronic health conditions? (circle for yes)

a) Arthritis or problems with his/her joints
b) Back problems
c) Cancer or leukemia
d) Diabetes
e) Hearing problems, even with a hearing aid
f) Heart disease/heart problems
g) High blood pressure/ circulation problems
h) Incontinence (for example, bowel or bladder accidents)
i) Kidney or liver disease
j) Lung conditions such as asthma, emphysema, or chronic bronchitis
k) Mental health issues such as depression or nerves [INTERVIEWER: other than memory problems]
l) Myopathies or other neuromuscular disorders (muscular dystrophy, myositis ossificans)
m) Stroke or physical effects of a stroke
n) Stomach/digestive problems
o) Teeth, gum, denture problems
p) Thyroid condition
q) Alcohol or drug problems
r) Vision problems, not helped by glasses or contact lenses (for example, glaucoma or macular degeneration)
s) Other specify:
t) Other specify:
Appendix B. Mini-Mental State Examination (Folstein et al., 1975)

REMOVED DUE TO COPYRIGHT
Appendix C. Acceptability & Feasibility Questions (Exercise-Practitioner Session Logs)

<table>
<thead>
<tr>
<th>During this session, how much did the participant:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
<th>For the entire session</th>
</tr>
</thead>
<tbody>
<tr>
<td>engage in the program</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>understand the material and protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>complete the protocol without additional instruction using physical cues or assistance</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>perform at the prescribed intensity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>get frustrated by the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During this session, how much did you:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
<th>For the entire session</th>
</tr>
</thead>
<tbody>
<tr>
<td>feel that you adequately addressed the questions and concerns of the dyad</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>adhere to the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>enjoy leading the session</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feel confident in ability to deliver program effectively</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix D. Trail Making Test – Part B (Arbuthnott & Frank, 2000; Lezak et al., 2004)

Instructions:
The Trail Making Test (Part B) consists of 25 circles distributed over a sheet of paper. The circles include both numbers (1 – 13) and letters (A – L). The patient draws lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The patient should be instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper. Time the patient as he or she connects the "trail." If the patient makes an error, point it out immediately and allow the patient to correct it. Errors affect the patient’s score only in that the correction of errors is included in the completion time for the task. It is unnecessary to continue the test if the patient has not completed both parts after five minutes have elapsed.

Step 1: Give the patient a copy of the Trail Making Test Part B worksheet and a pen or pencil.
Step 2: Demonstrate the test to the patient using the sample sheet (Trail Making Part B - SAMPLE).
Step 3: Time the patient as he or she follows the “trail” made by the numbers on the test.
Step 4: Record the time.

Scoring:
Results for TMT B are reported as the number of seconds required to complete the task; therefore, higher scores reveal greater impairment.
Average Deficient Rule of Thumb
Trail B 75 seconds > 273 seconds Most in 3 minutes
Trails B
Appendix E. 30-second chair stand test (Rikli & Jones, 2013)

Purpose: to assess lower-body strength

Equipment: straight-back chair, stopwatch

Procedure:
• Have the participant sit in the middle of the chair, feet flat on the floor, arms across chest
• On the signal "go", have the participant rise to a full stand, then return to a fully seated position
• After one or two warm-up repetitions to check for correct form, administer one test trial
• The score is the number of stands completed in 30 seconds

☐ Warm-up trial successful

Score: ________ sit to stand repetitions

What chair in home was used for test completion? __________________

Hands used? 0 No 1 Yes
Appendix F. Modified Berg Balance Scale (Kenny et al., 2008; McGough, Logsdon, Kelly & Teri, 2013)

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>SCORE (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting to standing</td>
<td></td>
</tr>
<tr>
<td>Standing unsupported</td>
<td></td>
</tr>
<tr>
<td>Sitting unsupported</td>
<td></td>
</tr>
<tr>
<td>Standing to sitting</td>
<td></td>
</tr>
<tr>
<td>Standing with eyes closed</td>
<td></td>
</tr>
<tr>
<td>Standing with feet together</td>
<td></td>
</tr>
<tr>
<td>Retrieving object from floor</td>
<td></td>
</tr>
<tr>
<td>Turning to look behind</td>
<td></td>
</tr>
<tr>
<td>Turning 360 degrees</td>
<td></td>
</tr>
<tr>
<td>Standing with one foot in front</td>
<td></td>
</tr>
<tr>
<td>Standing on one foot</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>_______</strong></td>
</tr>
</tbody>
</table>

**GENERAL INSTRUCTIONS**

Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- the time or distance requirements are not met
- the subject’s performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand. Chairs used during testing should be a reasonable height.
Berg Balance Scale

SITTING TO STANDING
INSTRUCTIONS: Please stand up. Try not to use your hand for support.
( ) 4 able to stand without using hands and stabilize independently
( ) 3 able to stand independently using hands
( ) 2 able to stand using hands after several tries
( ) 1 needs minimal aid to stand or stabilize
( ) 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED
INSTRUCTIONS: Please stand for two minutes without holding on.
( ) 4 able to stand safely for 2 minutes
( ) 3 able to stand 2 minutes with supervision
( ) 2 able to stand 30 seconds unsupported
( ) 1 needs several tries to stand 30 seconds unsupported
( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL
INSTRUCTIONS: Please sit with arms folded for 2 minutes.
( ) 4 able to sit safely and securely for 2 minutes
( ) 3 able to sit 2 minutes under supervision
( ) 2 able to able to sit 30 seconds
( ) 1 able to sit 10 seconds
( ) 0 unable to sit without support 10 seconds

STANDING TO SITTING
INSTRUCTIONS: Please sit down.
( ) 4 sits safely with minimal use of hands
( ) 3 controls descent by using hands
( ) 2 uses back of legs against chair to control descent
( ) 1 sits independently but has uncontrolled descent
( ) 0 needs assist to sit
STANDING UNSUPPORTED WITH EYES CLOSED
INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.
( ) 4 able to stand 10 seconds safely
( ) 3 able to stand 10 seconds with supervision
( ) 2 able to stand 3 seconds
( ) 1 unable to keep eyes closed 3 seconds but stays safely
( ) 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER
INSTRUCTIONS: Place your feet together and stand without holding on.
( ) 4 able to place feet together independently and stand 1 minute safely
( ) 3 able to place feet together independently and stand 1 minute with supervision
( ) 2 able to place feet together independently but unable to hold for 30 seconds
( ) 1 needs help to attain position but able to stand 15 seconds feet together
( ) 0 needs help to attain position and unable to hold for 15 seconds

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION
INSTRUCTIONS: Pick up the shoe/slipper, which is place in front of your feet.
( ) 4 able to pick up slipper safely and easily
( ) 3 able to pick up slipper but needs supervision
( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently
( ) 1 unable to pick up and needs supervision while trying
( ) 0 unable to try/needs assist to keep from losing balance or falling

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING
INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.
( ) 4 looks behind from both sides and weight shifts well
( ) 3 looks behind one side only other side shows less weight shift
( ) 2 turns sideways only but maintains balance
( ) 1 needs supervision when turning
( ) 0 needs assist to keep from losing balance or falling
TURN 360 DEGREES
INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.
(    ) 4 able to turn 360 degrees safely in 4 seconds or less
(    ) 3 able to turn 360 degrees safely one side only 4 seconds or less
(    ) 2 able to turn 360 degrees safely but slowly
(    ) 1 needs close supervision or verbal cuing
(    ) 0 needs assistance while turning

STANDING UNSUPPORTED ONE FOOT IN FRONT
INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject’s normal stride width.)
(    ) 4 able to place foot tandem independently and hold 30 seconds
(    ) 3 able to place foot ahead independently and hold 30 seconds
(    ) 2 able to take small step independently and hold 30 seconds
(    ) 1 needs help to step but can hold 15 seconds
(    ) 0 loses balance while stepping or standing

STANDING ON ONE LEG
INSTRUCTIONS: Stand on one leg as long as you can without holding on.
(    ) 4 able to lift leg independently and hold > 10 seconds
(    ) 3 able to lift leg independently and hold 5-10 seconds
(    ) 2 able to lift leg independently and hold ≥ 3 seconds
(    ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.
(    ) 0 unable to try of needs assist to prevent fall
Appendix G. 8-foot Walk Test (Bohannon, 2008)

Purpose: to measure comfortable and fast gait speed

Equipment: 8-foot unobstructed walking course, stopwatch

Procedure:
- Identify an 8-foot unobstructed walking course in participant's home, and mark off accordingly
- Instruct participant to begin with their toes behind the starting line
- On the instruction “go”, begin timing once the participant crosses the starting line
- Stop timing once the participant's first foot touches the floor beyond the end line
- Two trials will be completed with the participant being asked to walk at a “comfortable speed”
- Two trials will then be completed with the participant being asked to walk “as fast as you safely can”
- Scores will be the average of two trials for comfortable gait speed and fast gait speed

COMFORTABLE SPEED          FAST SPEED
Trial 1: __________ seconds   Trial 1: __________ seconds
Trial 2: __________ seconds   Trial 2: __________ seconds

Where in home was test completed? _________________________________

Assistive device used? 0 None 1 Cane 2 Walker
Appendix H. Activities of Daily Living Scale (Benjamin Rose Institute, 1992; Katz et al., 1963; Lawton & Brody, 1969)

Please tell me whether the following activities were difficult: (no difficulty=0; little difficulty=1; fair amount of difficulty=2; very difficult=3)

a) Writing checks, paying bills, or balancing a checkbook?
b) Assembling tax records, business affairs, or papers?
c) Shopping alone (for clothes, household necessities, or groceries)?
d) Playing a game of skill or working on a hobby?
e) Heating water, making a cup of coffee, or turning off the stove?
f) Preparing a meal?
g) Keeping track of current events?
h) Paying attention to or understanding things: for example, a TV show, book, or magazine?
i) Remembering appointments, family occasions, holidays, or medications?
j) Traveling out of the neighborhood, driving, or arranging to take buses?
k) Eating [including cutting food or buttering bread]?
l) Toileting [including getting to the bathroom in time, remembering to go to the bathroom, or cleaning yourself]?
m) Washing or bathing [including getting in and out of the tub or shower]?
n) Dressing or undressing?
o) Grooming [including combing and shampooing hair, or trimming nails]?
p) Getting in and out of bed or a chair?
Appendix I. Telephone Screening Form

A HOME-BASED EXERCISE PROGRAM FOR THOSE WITH MEMORY PROBLEMS
Initial Screening and Release of Information Form

Participant Name __________________________________________ Date ______________________
Phone Number ___________________________ Care Partner Name ___________________________

Please ask individual following questions to ensure individual meets inclusion criteria:

1. Do you have memory problems that affect your daily activities? Y N
2. Are you at least 60 years old? Y N
3. Do you live in the community? Y N
4. Do you have someone that will be available to help during each exercise session? Y N
5. Can you walk around your house on your own with or without a cane/walker? Y N

If they answer yes to each of the above questions, please ask the following question to ensure exclusion is not necessary:

6. Do you have or have you had Parkinson’s disease, Y N
   a brain tumor, Y N
   a brain injury, Y N
   muscular dystrophy, or Y N
   myositis ossificans? Y N

If participant meets all criteria for participation in current study, please obtain consent for release of contact information to research team for further assessment. If participant answers yes to any conditions in question 6, please thank them for their time and refer them to the research team for with further questions – Nicole Dawson, P.T. (330) 620-6365 or ndawson31@gmail.com.

“Thank you for answering those questions, we would like to send this information to the research team for further review. Someone from the team will contact you about scheduling time to come to your home for further testing. All information obtained will be used only for the research study so it will remain confidential. Participation in this project is completely voluntary. There will be no consequence to you if you decide to not proceed. Do you authorize the Alzheimer’s Association to release your contact information to Nicole Dawson, P.T. for purposes of participation in a research study investigating the effects of a home-based moderate-intensity exercise intervention for those with memory problems?”

☐ Verbal consent obtained Signature: ___________________________ Association Staff Member

Did dyad participate in previous RDAD program? Y N

COMMENTS: __________________________________________________________________________
Appendix J. Physician Notification of Participation

NOTIFICATION OF RESEARCH PARTICIPATION

Participant’s Name: _______________________________________________

Date of birth: ____________________________________________________

Physician’s name: _________________________________________________

Address: _________________________________________________________

Telephone number: _______________________________________________

Date: __________________________________________________________________

Dear Dr. ____________________________,

This letter is to inform you that your patient, ______________________, has enrolled in an ongoing research study titled “Examining the Effects of a Home-based Moderate-intensity Functional Exercise Intervention on Cognition, Function, and Psychological Well-being in Individuals with Dementia”. This project is being completed by Nicole Dawson, PT, MA, GCS under the supervision of Katherine Judge, Ph.D. in the Department of Psychology at Cleveland State University. It is supported by the Dissertation Research Award through the Office of Research at Cleveland State University.

Your patient will participate in a 12-week individualized, home exercise program including moderate-intensity functional strength and balance activities being led by the research team. No overt neurological or muscular diseases were identified during the screening process that would immediately exclude your patient from participation in the current project. Appropriate safety precautions are in place to minimize risk of injury through participation.

Please feel free to contact me immediately if with questions or concerns about your patient’s participation in the project. Thank you in advance for your consideration and support.

Professionally yours,

Nicole Dawson, PT, MA, GCS
Ph.D. Candidate, Adult Development & Aging
Department of Psychology
Cleveland State University
(330) 620-6365
Appendix K. Summary of Baseline Performance

SUMMARY OF PERFORMANCE FORM

Participant name: ______________________________________

Initial baseline completed on _____________________________

Medical information: ____________________________________

Participant’s Physical Function Group: __________

Assistive device: _______________________________________

30-second chair stand: _________________________________

Gait speed: __________________________________________

Modified Berg: _______________________________________

Comments: __________________________________________
EXAMINING EFFECTS OF A HOME-BASED EXERCISE PROGRAM FOR THOSE WITH MEMORY PROBLEMS

Participant & Care Partner Information Packet

Participant name ____________________________
Care Partner name ____________________________

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Exercise Coach

Name: ____________________________
Phone Number: ____________________________
Thank you for agreeing to be a part of this exciting exercise program for individuals with memory problems! The material in this packet will provide you with information about the program as well as exercise in general. Each session will be outlined so that you have a good idea of what is going to happen each time you meet with your exercise coach.

In the back of the manual, there are multiple resources to hopefully answer any questions that you might have about exercise and its effects. Following your exercise session, you might have some temporary muscle soreness. Please use the tips in the manual to help manage these symptoms. Do not hesitate to ask your exercise coach additional questions if you want. There is space at the beginning of each session so you can make notes to help you remember what you want to discuss with your exercise coach.

At any time during the program, you can decide that you want to stop. Your participation is much appreciated but is completed voluntary. You can contact Nicki Dawson, P.T. at (330) 620-6365 to discuss any questions or concerns throughout your time in the exercise program.

The study is funded by the Dissertation Research Award from Cleveland State University.
SESSION 1  
(Week 1)

Prior to initial visit:

☐ Make sure you have comfortable clothing and shoes for exercise  
☐ Please remove clutter in an area of your home to allow enough room to safely move during each exercise session

INTRODUCTION AND OVERVIEW

Thank you again for agreeing to be part of this exciting exercise program! This is a program that is going to be designed specially for you by your exercise coach so you can have fun and be as successful as possible. Please feel free to ask any questions or voice any concerns at any time during the program.

BENEFITS OF EXERCISE

Exercise can be one of the healthiest things that you do for yourself and your health. Regular exercise has been shown to prevent or delay many diseases or disabilities including heart disease, certain forms of cancer, and diabetes. Exercise can also improve your strength, walking ability, and balance. Improving strength and balance may help you stay independent longer with daily tasks like dressing, bathing, and toileting. Participation in a regular exercise program can possibly reduce your risk for falls.

Not only can exercise help with physical health, but some research has found that exercise may help you manage stress and improve your mood. Exercise may help you with some of your cognitive function, which is important in many daily tasks like shopping, cooking, and completing leisure activities.
INVolVEMENT IN CURRENT PROGRAM

The exercise program has sessions twice a week over a 12-week period for a total of 24 sessions. Each session will take about an hour with two (2) leg strength and two (2) balance exercises selected for you based on your current physical ability. So the program is tailored based on your needs and abilities.

Participant

You are going to perform a total of four (4) different exercises each session. Two (2) will focus on leg strength and two (2) will focus on balance. You will complete two (2) sets of each exercise. You will be asked to work as hard as you can and we will help find the right level of difficulty for you. During the first 2 weeks, we want you to be able to complete only 15 repetitions of the strengthening exercises and want your posture to be challenged during the balance exercises. Once you get used to the program, we will challenge you a little more.

You will set your own pace during the exercises, but we will coach and encourage you to help you work as hard as you can. Make sure you tell us if you become frustrated with the exercise, have any pain, or need a rest break. Also ask us to show you the exercise in a different way if we did not communicate it well. Your comfort and success are very important to us.

Based on how you performed on the first day of testing, different groups of exercises will be available for you to complete. You will always be given a choice of two (2) different exercises from each group. You pick which one you would rather do.

Your exercise coach will instruct you on how to do the exercise safely and most efficiently to make sure you get the best results. If the exercise coach is not clear, please ask for a demonstration. Once you understand, you will try it once or twice to make sure it feels comfortable.

Your exercise coach may add some resistance to the exercise using a medicine ball or a weighted belt so that you get the best results. Please let your exercise coach know if you have any discomfort or pain during any exercise. There should be no pain during any activity.
Care Partner

Your care partner will be asked to occasionally participate in the exercise program. Most often, this will occur during balance activities when a second person is needed to safely complete the exercise. For example, if you choose to toss a ball back and forth, we will need to stand by you to make sure you do not lose your balance. So your care partner will be the one to toss the ball with you.

In addition to taking part in some exercises, your care partner will help you keep track of any questions or problems throughout the program. We will discuss these at the beginning of each session.

**Following exercise session:**

Please feel free to keep notes between sessions about how you feel after each session. You can also use the space provided at the beginning of each session to help you remember anything you want to discuss with your exercise coach.

Thank you for participating in the program. Have fun and enjoy!
SESSION 2  
(Week 1)

WELCOME BACK

Prior to visit:
- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 
5. 

7
SESSION 3
(Week 2)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. _____________________________
2. _____________________________
3. _____________________________
4. _____________________________

SESSION 4
(Week 2)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. _____________________________
2. _____________________________
3. _____________________________
4. _____________________________
SESSION 5
(Week 3)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ________________________________________________
2. ________________________________________________
3. ________________________________________________
4. ________________________________________________

****You should be getting more comfortable with the exercise program.
This week, your exercise coach is going to ask you to work a little harder
with maybe a little more resistance or moving a little faster.

SESSION 6
(Week 3)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ________________________________________________
2. ________________________________________________
3. ________________________________________________
4. ________________________________________________
SESSION 7
(Week 4)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

SESSION 8
(Week 4)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

SESSION 9
(Week 5)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ___________________________________________
2. ___________________________________________
3. ___________________________________________
4. ___________________________________________

SESSION 10
(Week 5)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ___________________________________________
2. ___________________________________________
3. ___________________________________________
4. ___________________________________________
SESSION 11
(Week 6)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 

2. 

3. 

4. 

SESSION 12
(Week 6)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 

2. 

3. 

4. 

12
SESSION 13  
(Week 7)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. _________________________________
2. _________________________________
3. _________________________________
4. _________________________________

SESSION 14  
(Week 7)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. _________________________________
2. _________________________________
3. _________________________________
4. _________________________________

13
SESSION 15
(Week 8)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 

2. 

3. 

4. 

SESSION 16
(Week 8)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 

2. 

3. 

4. 
SESSION 17
(Week 9)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

SESSION 18
(Week 9)

Prior to visit:

- Make sure you have comfortable clothing and shoes for exercise
- Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
- Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

15
SESSION 19
(Week 10)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

SESSION 20
(Week 10)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 
SESSION 21
(Week 11)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ______________________________________
2. ______________________________________
3. ______________________________________
4. ______________________________________

SESSION 22
(Week 11)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ______________________________________
2. ______________________________________
3. ______________________________________
4. ______________________________________
SESSION 23
(Week 12)

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room
to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. ________________________________
2. ________________________________
3. ________________________________
4. ________________________________

You are almost there. There is only one more session to complete the
program. Feel free to talk about continuing your physical activity program
on your own with your exercise coach at the end of the program. We would
be happy to share any resources that you would like.
SESSION 24
(Week 12)
FINAL SESSION

Prior to visit:

☐ Make sure you have comfortable clothing and shoes for exercise
☐ Please remove clutter in an area of your home to allow enough room to safely move during each exercise session
☐ Note any problems or concerns between sessions

THINGS WE WANT TO DISCUSS WITH OUR EXERCISE COACH:

1. 
2. 
3. 
4. 

Congratulations!!! You have completed the exercise program. The research team will be in contact with you about scheduling the final assessment.

We can’t thank you enough for your dedication to the program. We hope you enjoyed it as much as we did!
MUSCLE SORENESS FOLLOWING EXERCISES

Any activity that you are not used to may lead to muscle soreness. Soreness may happen during the activity or even 1-2 days after. This delayed soreness is called DOMS (delayed muscle onset soreness). Some common symptoms of DOMS may include:

- Localized muscle pain or soreness
- Swelling in the area
- Stiffness or reduced motion of the joint
- Tenderness to touch
- Temporary weakness of the muscle

Do not be alarmed if you have these symptoms. Medical treatment is usually not needed. If the pain becomes terrible, there is a lot of swelling, or if your urine becomes dark, medical treatment may be needed.

Prevention

- Progress slowly into the exercise program
- Adequate warm-up will also help prepare the muscle for exercise
- Allow rest days in between strength exercises to allow muscle tissue to recover

Managing and Easing Soreness

Treatments such as ice packs, gentle massage, and oral pain relief agents (if approved by your physician) may be useful in easing pain and soreness.

No Pain, No Gain?

Muscle soreness is common when beginning a new exercise program. But, pain should not be present at any time. You do not need to hurt to get stronger! Pain is telling you to reduce or change your activity.

Please be sure to alert your exercise coach of any symptoms you are having so that your exercise program can be modified if necessary!

EXAMINING EFFECTS OF A HOME-BASED EXERCISE PROGRAM FOR THOSE WITH MEMORY PROBLEMS

Practitioner Exercise Protocol Manual
Thank you for agreeing to be a part of this exciting exercise intervention for individuals with dementia (IWD)! The purpose of this project is to better understand the effects of exercise on the cognition, function, and psychological well-being of IWDs. The information in this manual includes each session's protocol along with any resources that you will need such as the full list of exercises so that you can follow along during each interaction with the participants. Each session is outlined with particular steps to follow to standardize each program. Use the information that is italicized as a script to ensure that you provide the necessary information to each dyad. With that said, since every IWD and caregiver will be different, the protocol does allow for a certain level of flexibility.

The exercise intervention is a moderate-intensity home-based functional exercise program that includes both lower extremity strengthening and balance exercises. This program was designed using principles from exercise science while accounting for the specialized needs of IWDs.

Prior to your initial session with the dyad, a baseline assessment was completed by the research team. This assessment consisted of questions regarding past medical history, overall health status, symptoms of depression, cognitive abilities, and their perceived ability to complete daily tasks. There were also some physical performance measures taken assessing walking ability, balance, and lower extremity strength. The summary of physical performance form will allow to have a starting point individualized for each participant. This assessment will also be administered upon completion of the 12-week exercise program.

You should have received the necessary exercise equipment toolkit to complete each session with the participant. This toolkit should include:
- Exercise protocol manual
- Access to Google drive (calendar & tracking sheet)
- Stopwatch
- Gait belt with handles
- Medicine ball set
- Weighted vest (20 lbs.)
- Balance pad
- Cone set
- Spot markers

If you did not receive all items in this list, please contact Nicki Dawson, P.T. at (330) 620-6365. Thank you again for your assistance with this program. Good luck!
SECTIONS 1-4

INITIAL EXERCISE SESSIONS

Acclimation to Program

1. Review Physical Function Group and obtain appropriate list of exercises based on possible categories (see Resource Section)

2. Remind the participant that you will be completing a total of 4 exercises – 2 strength and 2 balance activities

After a short warm-up, we are going to perform a total of four (4) different exercises today. We will alternate strength and balance exercises with two (2) focusing on leg strength and two focusing on balance. We will complete two (2) sets of each exercise.

You will be asked to work as hard as you can and I will help find the right level of difficulty for you. You will self-pace the exercises, but I will coach and encourage you to help you work as hard as you can.

3. Complete warm-up exercises

We are going to warm up your body so you can complete the exercises a little easier.

Warm-up exercises
• Walking on the spot
• Opposing arm-swings at the side of the body
• "picking apples" in various directions (up, sideways, down)
• Knee stretches with right and left leg alternately
• steps to the side and back with right and left foot alternately

Feel free to adapt other warm-up exercises according to patient ability and preferences, be sure to address major muscle and joints.
4. Give them a choice of 2 exercises for the first activity

Here are two examples of the strength exercises designed for you:

____________________ or __________________

Which one would you like to start with (record chosen task in activity log)? Excellent choice! Let’s get started.

5. Begin the first strength activity

- Describe the activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a resistance that you best predict will allow the participant to safely complete 15 repetitions to fatigue

I want you to do as many repetitions that you can until you are tired and cannot complete any more safely.

- Count repetitions completed by participant. If participant is able to complete more than 15 repetitions comfortably, stop at 25 repetitions and note that intensity was too light on at this set.
- Ensure participant is comfortably breathing throughout the activity with no pain
- Following set completion, rest for 1 minute
- Complete a second set
  - Modify level of intensity if necessary based on performance from 1st set
    - If participant was not able to complete 15 repetitions, lighten resistance or modify activity to make easier
    - If participant completed more than 15 repetitions, add resistance or make activity more challenging
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
- Rest 1 minute
6. Move to balance activity

   o Give the participant choice of 2 balance activities

Here are two examples of the balance exercises designed for you:

____________________ or ________________

Which one would you like to start with (record chosen task in activity log)?
Excellent choice! Let’s get started.

   o Describe the chosen activity to the participant
      ▪ Use 1-2 step instructions relying on familiar and everyday language
      ▪ Demonstrate the activity
   o Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
   o Choose a level of difficulty that will challenge the participant’s full-body postural stability
      ▪ Involve caregiver as needed if partner required for task (e.g., ball toss)
   o Complete activity for 1 minute
   o Ask participant if activity was challenging

Was that easy or difficult for you?

   o Rest for 1 minute
   o Repeat for a total of 2 repetitions
      ▪ Modify level of difficulty if needed based on performance in first set
   o Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
   o Rest for 1 minute

7. Complete second strengthening activity

   o Do not repeat same exercise completed in first set
Here are two examples of the strength exercises designed for you:

_______________ or ________________

Which one would you like to start with (record chosen task in activity log)?
Excellent choice! Let’s get started.

- Describe the activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a resistance that you best predict will allow the participant to safely complete 15 repetitions to fatigue

I want you to do as many repetitions that you can until you are tired and cannot complete any more safely.

- Count repetitions completed by participant. If participant is able to complete more than 15 repetitions comfortably, stop at 25 repetitions and note that intensity was too light on at this set.
- Ensure participant is comfortably breathing throughout the activity with no pain
- Following set completion, rest for 1 minute
- Complete a second set
  - Modify level of intensity if necessary based on performance from 1st set
    - If participant was not able to complete 15 repetitions, lighten resistance or modify activity to make easier
    - If participant completed more than 15 repetitions, add resistance or make activity more challenging
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
- Rest 1 minute
8. Complete second balance activity

- Do not repeat same exercise completed in first set
- Give the participant choice of 2 balance activities

Here are two examples of the balance exercises designed for you:

_____________________ or ___________________

Which one would you like to start with (record chosen task in activity)? Excellent choice! Let’s get started.

- Describe the chosen activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a level of difficulty that will challenge the participant's full-body postural stability
  - Involve caregiver as needed if partner required for task (e.g., ball toss)
- Complete activity for 1 minute
- Ask participant if activity was challenging

Was that easy or difficult for you?

- Rest for 1 minute
- Repeat for a total of 2 repetitions
  - Modify level of difficulty if needed based on performance in first set
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
SESSIONS 5-24

1. Review Physical Function Group and obtain appropriate list of exercises based on possible categories

2. Remind the participant that you will be completing a total of 4 exercises – 2 strength and 2 balance activities

After a short warm-up, we are going to perform a total of four (4) different exercises today. We will alternate strength and balance exercises with two (2) focusing on leg strength and two focusing on balance. We will complete two (2) sets of each exercise.

You will be asked to work as hard as you can and we will help find the right level of difficulty for you. You will self-pace the exercises, but we will coach and encourage you to help you work as hard as you can.

3. Complete warm-up exercises

We are going to warm up your body so you can complete the exercises a little easier.

Warm-up exercises
- Walking on the spot
- Opposing arm-swings at the side of the body
- “picking apples” in various directions (up, sideways, down)
- Knee stretches with right and left leg alternately
- steps to the side and back with right and left foot alternately

Feel free to adapt other warm-up exercises according to patient ability and preferences, be sure to address major muscle and joints.
4. Give them a choice of 2 exercises for the first activity

*Here are two examples of the strength exercises designed for you:*  
________________________ or ____________________

*Which one would you like to start with (record both options and chosen task in activity log)? Excellent choice! Let’s get started.*

5. Begin the first strength activity

- Describe the activity to the participant  
  - Use 1-2 step instructions relying on familiar and everyday language  
  - Demonstrate the activity  
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely  
- Choose a resistance that you best predict will allow the participant to safely complete 8-12 repetitions to fatigue

*I want you to do as many repetitions that you can until you are tired and cannot complete any more safely.*

- Count repetitions completed by participant. If participant is able to complete more than 12 repetitions comfortably, stop at 20 repetitions and note that intensity was too light on at this set.  
- Ensure participant is comfortably breathing throughout the activity with no pain  
- Following set completion, rest for 1 minute  
- Complete a second set  
  - Modify level of intensity if necessary based on performance from 1st set  
    - If participant was not able to complete 8 repetitions, lighten resistance or modify activity to make easier  
    - If participant completed more than 12 repetitions, add resistance or make activity more challenging  
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)  
- Rest 1 minute
6. Move to balance activity

- Give the participant choice of 2 balance activities

*Here are two examples of the balance exercises designed for you:*

_________ or ___________

*Which one would you like to start with (record both options and chosen task in activity log in back of manual)? Excellent choice! Let’s get started.*

- Describe the chosen activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a level of difficulty that will challenge the participant’s full-body postural stability
  - Involve caregiver as needed if partner required for task (e.g., ball toss)
- Complete activity for 1 minute
- Ask participant if activity was challenging

*Was that easy or difficult for you?*

- Rest for 1 minute
- Repeat for a total of 2 repetitions
  - Modify level of difficulty if needed based on performance in first set
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
- Rest for 1 minute

7. Complete second strengthening activity

- Do not repeat same exercise completed in first set
Here are two examples of the strength exercises designed for you:

___________________ or __________________

Which one would you like to start with (record both options and chosen task in activity log)? Excellent choice! Let’s get started.

- Describe the activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant to demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a resistance that you best predict will allow the participant to safely complete 8-12 repetitions to fatigue

I want you to do as many repetitions that you can until you are tired and cannot complete any more safely.

- Count repetitions completed by participant. If participant is able to complete more than 12 repetitions comfortably, stop at 20 repetitions and note that intensity was too light on at this set.
- Ensure participant is comfortably breathing throughout the activity with no pain
- Following set completion, rest for 1 minute
- Complete a second set
  - Modify level of intensity if necessary based on performance from 1st set
    - If participant was not able to complete 8 repetitions, lighten resistance or modify activity to make easier
    - If participant completed more than 12 repetitions, add resistance or make activity more challenging
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
- Rest 1 minute
8. Complete second balance activity

- Do not repeat same exercise completed in first set
- Give the participant choice of 2 balance activities

*Here are two examples of the balance exercises designed for you:*

________________________ or ______________________

*Which one would you like to start with (record both options and chosen task in activity log in back of manual)? Excellent choice! Let’s get started.*

- Describe the chosen activity to the participant
  - Use 1-2 step instructions relying on familiar and everyday language
  - Demonstrate the activity
- Allow the participant demonstrate the activity with no resistance to ensure they understand the task and can complete safely
- Choose a level of difficulty that will challenge the participant’s full-body postural stability
  - Involve caregiver as needed if partner required for task (e.g., ball toss)
- Complete activity for 1 minute
- Ask participant if activity was challenging

*Was that easy or difficult for you?*

- Rest for 1 minute
- Repeat for a total of 2 repetitions
  - Modify level of difficulty if needed based on performance in first set
- Record parameters of activity on the activity log (name, intensity, repetitions, adverse events)
PRACTITIONER RESOURCES
### Recommended Exercise Categories

<table>
<thead>
<tr>
<th>Physical Function Group&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Recommended Categories in the Collection of exercises</th>
</tr>
</thead>
</table>
| 1 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 |
| 2 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 |
| 3 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 |

<sup>a</sup>The participant's need for personal support when walking a short distance (5-10 meters) without walking aid.
<table>
<thead>
<tr>
<th>Strength-Based Approach Technique</th>
<th>Potential Barriers</th>
<th>Cognitive Strength Being Used</th>
<th>Example of Applied Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping it Short &amp; Simple (K.I.S.S)</td>
<td>Frustration; inability to complete activity properly</td>
<td>Procedural memory; language comprehension</td>
<td>Reducing verbal cuing during instructions  e.g., &quot;Get up off of the floor&quot; instead of &quot;Roll over on your side and use your right hand and forearm to push up from the floor so you can stand up&quot;</td>
</tr>
<tr>
<td>External Memory Aids</td>
<td>Poor adherence despite willingness to participate; repetitive questions or demonstration</td>
<td>Simple attention; reading</td>
<td>Use of calendars; use of written instructions for exercises</td>
</tr>
<tr>
<td>Learning by Modeling</td>
<td>Frustration; inability to complete activity properly</td>
<td>Procedural memory; visuospatial functioning</td>
<td>Demonstrating activity with participants instead of relying on verbal cues only</td>
</tr>
<tr>
<td>Allowing IWD to Choose Activity</td>
<td>Boredom; poor adherence</td>
<td>Procedural memory</td>
<td>Giving IWD choice of 2 to 3 possible activities</td>
</tr>
</tbody>
</table>
List of possible exercises per category:

<table>
<thead>
<tr>
<th>Category</th>
<th>Base exercise</th>
<th>Increase intensity</th>
<th>Progress within category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Walking lunge</td>
<td>Add resistance</td>
<td>Deepen lunge</td>
</tr>
<tr>
<td></td>
<td>Forwardside lunge</td>
<td>Add resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step-ups</td>
<td>Add resistance; raise height of step</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Floor to stand</td>
<td>Add resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jumping</td>
<td>Add resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Squat</td>
<td>Add resistance</td>
<td>Deepen squat</td>
</tr>
<tr>
<td></td>
<td>Sit to stand</td>
<td>Add resistance</td>
<td>Lower chair; narrow stance</td>
</tr>
<tr>
<td>B</td>
<td>Stepping over obstacles</td>
<td>Increase speed; raise height or length of object</td>
<td>Add compliant surface</td>
</tr>
<tr>
<td></td>
<td>Lateral hopping</td>
<td>Add compliant surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heel/toe walking</td>
<td>Add uneven surface</td>
<td>Add medicine ball toss</td>
</tr>
<tr>
<td></td>
<td>Tandem walk</td>
<td>Add uneven or compliant surface</td>
<td>Add ball toss in air or with partner</td>
</tr>
<tr>
<td></td>
<td>Carrying ball behind back</td>
<td>Add uneven or compliant surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toss ball in air while walking</td>
<td>Add uneven or compliant surface</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Foot placement onto target</td>
<td>Increase speed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stand with narrow base of support</td>
<td>Close eyes</td>
<td>Toss medicine ball with eyes open; add compliant surface</td>
</tr>
<tr>
<td></td>
<td>Tandem stand</td>
<td></td>
<td>Add medicine ball toss or lateral pass</td>
</tr>
<tr>
<td></td>
<td>Item retrieval from floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball rolls with foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball kick</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Sit to stand (table/counter)</td>
<td>Add resistance</td>
<td>Remove use of hands for push up</td>
</tr>
<tr>
<td></td>
<td>Squat (table/counter)</td>
<td>Add resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heel raises (table/counter)</td>
<td>Add resistance</td>
<td>Remove supportive surface for hands</td>
</tr>
<tr>
<td>E</td>
<td>Forward walking</td>
<td>Increase speed; add resistance; add stops</td>
<td>Negotiate obstacles</td>
</tr>
<tr>
<td></td>
<td>Lateral walking</td>
<td>Increase speed; add resistance; add stops</td>
<td>Negotiate obstacles</td>
</tr>
</tbody>
</table>

**Reasons to terminate exercise:**
- Muscle failure
- Loss of form; safety risk
- Rest requested
- Talk Test: able to only say a few words
- Max reps achieved (20 or 25 reps)
- Pain

**Intensity for balance**
1. even surface
2. uneven surface
3. compliant surface
EXAMINING EFFECTS OF A HOME-BASED EXERCISE PROGRAM FOR THOSE WITH MEMORY PROBLEMS

Practitioner Session Log

<table>
<thead>
<tr>
<th>Participant Name ____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Visit 1</th>
<th>Visit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 1</td>
<td></td>
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<td>Week 2</td>
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<td>Week 11</td>
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<td>Week 12</td>
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<tr>
<td>Follow-up Assessment</td>
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</tbody>
</table>
Thank you for agreeing to be a part of this exciting exercise intervention for individuals with dementia (IWD)! The purpose of this project is to better understand the effects of exercise on the cognition, function, and psychological well-being of IWDs. The information in this manual includes each session’s protocol along with any resources that you will need such as the full list of exercises so that you can follow along during each interaction with the participants. Each session is outlined with particular steps in **bold** to follow to standardize each program. Use the information that is *italicized* as a script to ensure that you provide the necessary information to each dyad. With that said, since every IWD and caregiver will be different, the protocol does allow for a certain level of flexibility.

For each session you will need the *Practitioner Exercise Protocol Manual* and this *Practitioner Session Log* identified for your participant. This log must be maintained in a secure location and cannot be shared with anyone outside the research team due to confidentiality.

Following each session, please ensure that follow-up sessions have been scheduled and logged into the project calendar. Please update Excel tracking to assist in maintaining the most up to date project information and progress.

*If you have any questions or problems, please contact Nicki Dawson, P.T. at (330) 620-6365. Thank you again for your assistance with this program. Good luck!*

---

The study is funded by the Dissertation Research Award from Cleveland State University.
SESSION 1 (Week 1)

INTRODUCTION AND OVERVIEW

Prior to initial visit:

- Contact dyad and confirm initial appointment 24 hours prior
- Review summary of physical performance from the baseline
- Identify participant’s Physical Function Group based on walking performance during baseline assessment
  
  - Participant’s Physical Function Group: _________
  
  - Recommended Exercise Categories
    - Strength: A D
    - Balance: B C E

SESSION DATE: ________________  SESSION START TIME: ____________

Upon arrival to the participant’s home:

1. Please introduce yourself, describe your role as the exercise practitioner, and give dyad the information packet

   Thank you again for agreeing to be part of this exciting exercise program! This is a program that is going to be designed specially for you so you can have fun and be as successful as possible. Please feel free to ask any questions or voice any concerns at any time during the program.

2. Discuss potential benefits of exercise

BENEFITS OF EXERCISE

Exercise can be one of the healthiest things that you do for yourself and your health. Regular exercise has been shown to prevent or delay many diseases or disabilities including heart disease, certain forms of cancer, and diabetes. Exercise can also improve your strength, walking ability, and balance. Improving strength and balance may help you stay independent longer with daily tasks like dressing, bathing, and toileting. Participation in a regular exercise program can possibly reduce your risk for falls.

Not only can exercise help with physical health, but some research has found that exercise may help you manage stress and improve your mood. Exercise may help you with some of your cognitive function, which is important in many daily tasks like shopping, cooking, and completing leisure activities.
3. Describe and outline the exercise program to give the IWD and caregiver a better understanding of the schedule over the next 12 weeks

**INvolvement in Current Program**

The exercise program has sessions twice a week over a 12-week period for a total of 24 sessions. Each session will take about an hour with two (2) leg strength and two (2) balance exercises selected for you based on your current physical ability. So the program is tailored based on your needs and abilities.

**Participant**

You are going to perform a total of four (4) different exercises each session. Two (2) will focus on leg strength and two (2) will focus on balance. You will complete two (2) sets of each exercise. You will be asked to work as hard as you can and we will help find the right level of difficulty for you. During the first 2 weeks, we want you to be able to complete only 15 repetitions of the strengthening exercises and want your posture to be challenged during the balance exercises. Once you get used to the program, we will challenge you a little more.

You will set your own pace during the exercises, but we will coach and encourage you to help you work as hard as you can. Make sure you tell us if you become frustrated with the exercise, have any pain, or need a rest break. Also ask us to show you the exercise in a different way if we did not communicate it well. Your comfort and success are very important to us.

Based on how you performed on the first day of testing, different groups of exercises will be available for you to complete. You will always be given a choice of two (2) different exercises from each group. You pick which one you would rather do.

Your exercise coach will instruct you on how to do the exercise safely and most efficiently to make sure you get the best results. If the exercise coach is not clear, please ask for a demonstration. Once you understand, you will try it once or twice to make sure it feels comfortable.

Your exercise coach may add some resistance to the exercise using a medicine ball or a weighted belt so that you get the best results. Please let your exercise coach know if you have any discomfort or pain during any exercise. There should be no pain during any activity.

**Care Partner**

Your care partner will be asked to occasionally participate in the exercise program. Most often, this will occur during balance activities when a second person is needed to safely complete the exercise. For example, if you choose to toss a ball back and forth, we will need to stand by you to make sure you do not lose your balance. So your care partner will be the one to toss the ball with you.

In addition to taking part in some exercises, your care partner will help you keep track of any questions or problems throughout the program. We will discuss these at the beginning of each session.
4. Quickly (6-10 minutes max) discuss and note the dyad’s exercise history including likes and dislikes

Tell me about some of the things that you and ____________ [care partner] do for exercise:

________________________________________________________________________

What are your favorites?

________________________________________________________________________

What are some things that you really do not like doing?

________________________________________________________________________

5. Ask dyad if there are any concerns or questions prior to initiating initial exercise session

Do you have any questions or concerns before we get started on the exercises today?

________________________________________________________________________

________________________________________________________________________

INITIAL EXERCISE SESSION

Please refer to the Practitioner Exercise Protocol Manual pages 3-7 for today’s session protocol. Record session information below.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Intensity</th>
<th>Reps/Time</th>
<th>Adverse Events</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Notes:

________________________________________________________________________

________________________________________________________________________

*****If any adverse events (other than temporary symptoms that have resolved) occurred during or between sessions, contact Nicki Dawson, P.T. at (330) 620-6365 prior to continuation of session to determine appropriate steps.*****
Following exercise session:

1. Thank participant and caregiver for the effort and participation during session

2. Ensure follow-up sessions are scheduled appropriately and calendar has been given to dyad

*About an hour before the next session, I will let you that I am coming.*

3. Instruct dyad to maintain list of questions and concerns between now and next session in their notebook.

*We will review any questions or concerns about your participation in the program at the beginning of each session. Please feel free to write them down ahead of time at the top of each session page to help you remember to bring it up to us.*

*In the back of your packet, there is information on managing minor muscle or joint soreness. Feel free to use these strategies between sessions as muscle soreness may occur since you worked so hard during our session.*

4. Provide contact information for research team and encourage IWD and caregiver to call with any questions or concerns

*Here is my name and phone number if you have any questions before our next session. Please do not hesitate to call me. (Write your name and phone number on the packet of information for the dyad.)*

<table>
<thead>
<tr>
<th>During this session, how much did the participant:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
<th>For the entire session</th>
</tr>
</thead>
<tbody>
<tr>
<td>engage in the program</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>understand the material and protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>complete the protocol without additional instruction using physical cues or assistance</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>perform at the prescribed intensity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>get frustrated by the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During this session, how much did you:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
<th>For the entire session</th>
</tr>
</thead>
<tbody>
<tr>
<td>feel that you adequately addressed the questions and concerns of the dyad</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>adhere to the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>enjoy leading the session</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feel confident in ability to deliver program effectively</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

☐ Add scheduled sessions to project calendar
☐ Update Excel tracking log with session information

SEDITION END TIME: ______________

*****If any adverse events (other than temporary symptoms that have resolved) occurred during or between sessions, contact Nicki Dawson, P.T. at (330) 620-6365 prior to continuation of session to determine appropriate steps.*****
SESSIONS 2 through 23 (Weeks 1-12)

Prior to visit:

- Review last session
- Review participant’s Physical Function Group based on walking performance during baseline assessment
  - Participant’s Physical Function Group: _________
  - Recommended Exercise Categories
    - Strength: A D
    - Balance: B C E

SESSION DATE: ________________  SESSION START TIME: ________________

Upon arrival to the participant’s home:

1. Remind dyad of your name
2. Discuss questions or concerns identified since last session

   Do you have any questions or concerns that came up since our last session?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. Obtain consent to continue with current exercise session

   - Verbal consent from both participant and care partner received to continue


<table>
<thead>
<tr>
<th>Exercise</th>
<th>Intensity</th>
<th>Repetitions</th>
<th>Adverse Events</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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Following exercise session:

1. Thank participant and caregiver for the effort and participation during session

2. Ensure follow-up sessions are scheduled appropriately and calendar has been given to dyad

About an hour before the next session, I will let you that I am coming.

3. Instruct dyad to maintain list of questions and concerns between now and next session in their notebook.

We will review any questions or concerns about your participation in the program at the beginning of each session. Please feel free to write them down ahead of time at the top of each session page to help you remember to bring it up to us.

In the back of your packet, there is information on managing minor muscle or joint soreness. Feel free to use these strategies between sessions as muscle soreness may occur since you worked so hard during our session.

4. Provide contact information for research team and encourage IMD and caregiver to call with any questions or concerns

Here is my name and phone number if you have any questions before our next session. Please do not hesitate to call me. (Ensure your name and phone number are on the packet of information for the dyad.)

<table>
<thead>
<tr>
<th>During this session, how much did the participant:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>2</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During this session, how much did you:</th>
<th>Not at all</th>
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<tbody>
<tr>
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</tr>
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<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

☐ Add scheduled sessions to project calendar
☐ Update Excel tracking log with session information

Notes: ________________________________________________________________

SESSION END TIME: ____________

*****If any adverse events (other than temporary symptoms that have resolved) occurred during or between sessions, contact Nicki Dawson, P.T. at (330) 620-6385 prior to continuation of session to determine appropriate steps.*****

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SESSION 24 (Week 12)
FINAL SESSION

Prior to visit:

☐ Review last session
☐ Review participant’s Physical Function Group based on walking performance during baseline assessment
  - Participant’s Physical Function Group: _________
  - Recommended Exercise Categories
    - Strength: A D
    - Balance: B C E

SESSION DATE: _______________  SESSION START TIME: _______________

Upon arrival to the participant’s home:

1. Remind dyad of your name

2. Discuss questions or concerns identified since last session

Do you have any questions or concerns that came up since our last session?

________________________________________________________________________

3. Obtain consent to continue with current exercise session

☐ Verbal consent from both participant and care partner received to continue


<table>
<thead>
<tr>
<th>Exercise</th>
<th>Intensity</th>
<th>Repetitions</th>
<th>Adverse Events</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

*****If any adverse events (other than temporary symptoms that have resolved) occurred during or between sessions, contact Nicki Dawson, P.T. at (330) 620-6365 prior to continuation of session to determine appropriate steps.*****
Following exercise session:

1. Thank participant and caregiver for the effort and participation during the program
2. Advise dyad that research team will contact them regarding follow-up assessment

Congratulations!!! You have completed the exercise program. The research team will be in contact with you about scheduling the final assessment. Also, after the final assessment, we will be sharing some information and resources with you about healthy living including physical activity and nutrition. You can add that information to your packet to keep.

3. Provide contact information for research team and encourage MWD and caregiver to call with any questions or concerns

Here is my name and phone number if you have any questions before the final assessment. Please do not hesitate to call me. (Ensure your name and phone number are on the packet of information for the dyad.)

<table>
<thead>
<tr>
<th>During this session, how much did the participant:</th>
<th>Not at all</th>
<th>Some of the time</th>
<th>Most of the time</th>
<th>For the entire session</th>
</tr>
</thead>
<tbody>
<tr>
<td>engage in the program</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>understand the material and protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>complete the protocol without additional instruction using physical cues or assistance</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>perform at the prescribed intensity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>get frustrated by the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>During this session, how much did you:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>feel that you adequately addressed the questions and concerns of the dyad</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>adhere to the protocol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>enjoy leading the session</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feel confident in ability to deliver program effectively</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes: ________________________________________________________________

☐ Please ask participant final question about the program:
   1. How much did you enjoy the program?
   0 NOT AT ALL 2 IT WAS OKAY 3 LOVED IT, GREAT

☐ Number of total sessions completed ________/24
☐ Alert Nicki Dawson that final session has been completed
☐ Update Excel tracking log with session information

SESSION END TIME: ______________

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Appendix O. List of possible exercises per category: Base exercise (modifications to increase intensity)

<table>
<thead>
<tr>
<th>Category</th>
<th>Base exercise</th>
<th>Increase intensity</th>
<th>Progress within category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Forward/side lunge</td>
<td>Add resistance; deepen lunge</td>
<td>Walking lunge</td>
</tr>
<tr>
<td></td>
<td>Step-ups</td>
<td>Add resistance; raise height of step</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Squat</td>
<td>Add resistance; deepen squat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sit to stand</td>
<td>Add resistance; lower chair; narrow stance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stepping over obstacles</td>
<td>Increase speed; raise height or length of object</td>
<td>Add compliant surface</td>
</tr>
<tr>
<td></td>
<td>Lateral hopping</td>
<td>Add compliant surface</td>
<td>Add medicine ball toss</td>
</tr>
<tr>
<td></td>
<td>Heel/toe walking</td>
<td>Add uneven surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tandem walk</td>
<td>Add uneven or compliant surface</td>
<td>Add ball toss in air or with partner</td>
</tr>
<tr>
<td></td>
<td>Carrying ball behind back</td>
<td>Add uneven or compliant surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toss ball in air while walking</td>
<td>Add uneven or compliant surface</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Foot placement onto target</td>
<td>Increase speed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stand with narrow base of support</td>
<td>Close eyes</td>
<td>Toss medicine ball with eyes open; add compliant surface</td>
</tr>
<tr>
<td></td>
<td>Tandem stand</td>
<td></td>
<td>Add medicine ball toss or lateral pass</td>
</tr>
<tr>
<td></td>
<td>Item retrieval from floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball rolls with foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball kick</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Sit to stand (table/counter)</td>
<td>Add resistance</td>
<td>Remove use of hands for push up</td>
</tr>
<tr>
<td></td>
<td>Squat (table/counter)</td>
<td>Add resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heel raises (table/counter)</td>
<td>Add resistance</td>
<td>Remove supportive surface for hands</td>
</tr>
<tr>
<td>D</td>
<td>Forward walking</td>
<td>Increase speed; add resistance; add stops</td>
<td>Negotiate obstacles</td>
</tr>
<tr>
<td></td>
<td>Lateral walking</td>
<td>Increase speed; add resistance; add stops</td>
<td>Negotiate obstacles</td>
</tr>
</tbody>
</table>

*aNote.* Resistance will be added using weighted vest, medicine ball, or resisted band.