IMPACT OF A MULTI-COMPONENT EXERCISE AND PHYSICAL ACTIVITY PROGRAM FOR SEDENTARY, COMMUNITY-DWELLING, OLDER ADULTS

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Participation in physical activity is an evidence-based strategy for improving health in older adults. However, less than 30% of older adults engage in any form of regular physical activity. Despite the development of best practice recommendations, the impact of physical activity programs on older adult participation and the performance of activities of daily living (ADL) is not well understood. This dissertation examined best practice programs in relation to ADL performance through a literature review and an intervention study. Our systematic review identified 15 studies on multi-component, group, exercise interventions for community-dwelling older adults. Studies varied greatly in terms of setting, sample size, mode of exercise, length of intervention, and outcomes, and only four studies included all the recommendations of best practice. ADL performance was the least frequently included outcome, supporting the need for additional research. Our pretest, posttest, and post-posttest cohort study evaluated the effects of a 10 week, multi-component, best practice, exercise program on physical activity, ADL performance, physical performance, and depression in community-dwelling, older adults from low-income households ($N = 15$). Comparison of pretest and posttest scores using a one-tailed paired samples t-test resulted in improvement ($p < .05$) for 2 of 3 ADL domains on the Activity Measure-Post Acute Care (AM-PAC) and on all 6 physical performance measures of the Senior Fitness Test (SFT), with medium to large effect sizes for all measures. The Geriatric Depression Scale (GDS) yielded no significant change. Physical activity was evaluated at pretest, at 4 weeks posttest, and at 8 weeks post-posttest using the Yale Physical Activity Scale (YPAS). Repeated

measures ANOVA revealed significant main effects for 3 of 8 measures - Total Activity Hours, Total Energy Expenditure, and the Leisurely Walking Index. Post-hoc analysis using the Bonferroni adjustment was significant only for the Leisurely Walking Index from pretest to posttest. Retention rate was 78.9%, and the adherence rate for group sessions was 89.7%. These results suggest that implementation of a multi-component, best practice exercise and physical activity program with sedentary, community-dwelling older adults may be well tolerated and may positively impact physical activity, ADL performance, and physical performance.

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PREFACE

I would like to express my deepest appreciation and thanks to my dissertation chair and advisor, Joan C. Rogers, PhD, OTR/L, for her patience and guidance throughout this process. You have been a wonderful mentor! I appreciate your support and encouragement, which gave me the confidence to research a topic of great importance to me. I would like to thank the members of my dissertation committee, Margo Holm, PhD, OTR/L, Ketki D. Raina, PhD, OTR/L, and Elizabeth A. Schlenk, PhD, RN for guiding me through this dissertation process. I greatly appreciate the time and effort you have invested in me.

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1.0 INTRODUCTION

1.1 BACKGROUND

The health promotion benefits of increased physical activity for older adults are well documented (Abbott et al., 2004; Buchner, Beresford, Larson, LaCroix, & Wagner, 1992; Fiatarone et al., 1994; Seguin & Nelson, 2003). In addition to its impact on health, physical activity has been correlated with reduced healthcare costs, prevention of frailty, and increased quality of life (Ackerman et al., 2008; Courtney et al., 2009; Peterson et al., 2009). Despite the evidence, most adults do not engage in sufficient levels of regular exercise or physical activity to provide a health benefit (Rhodes et al., 1999). Inactivity has been recognized internationally as a public health concern and strategies have been initiated within the United States and abroad to address this issue (U.S. Department of Health and Human Services, 2008; World Health Organization, 2010). While physical activity levels are low for the general adult population, older adults are even less likely to engage in physical activity (Agency for Healthcare Research and Quality, 2002; Kruger, Carlson, & Buchner, 2007). Real barriers such as poor health and unsupportive physical environments, as well as perceived barriers such as decreased self-efficacy and social myths regarding exercise, all affect older adult participation in physical activity (Boyette et al., 2002; Brawley et al., 2003; Burbank & Riebe, 2002; Schutzer & Graves, 2004).

With an aging population being one of the most significant trends affecting healthcare costs and global health, increasing physical activity in older adults has become a critical necessity from both a financial and social perspective (Agency for Healthcare Research and Quality, 2002; King, Rejeski, & Buchner, 1998; World Health Organization, 2010).

In 2004, the American College of Sports Medicine (ACSM) created *best practice* guidelines for increasing physical activity for older adults. These guidelines recommend multi-component exercise programs that are group-based and incorporate behavioral change strategies. Updates on this position by the ACSM et al. (2009), the American Heart Association (Nelson et al., 2007), and guidelines published by the U.S. Department of Health and Human Services (U.S. DHHS, 2008) recommend that older adults regularly participate in multi-component physical activity programs that address endurance, strength, flexibility, and balance for those with increased falls risk or mobility limitations. The ACSM suggests group-based programs over individual programs, and the incorporation of behavioral change principles as critical elements for initiating and maintaining physical activity in older adults. In addition to the development of these guidelines, the ACSM partnered with several other professional organizations to create and endorse an Active Aging Toolkit. Developed to assist healthcare providers in promoting the benefits of physical activity, this toolkit includes a scientifically-based, low-cost, progressive, multi-component exercise program titled the First Step to Active Health (FSAH; Human Kinetics, 2004; Page et al., 2004).

Despite these recommendations, guidelines, toolkits and programs like the FSAH, most research on physical activity and exercise for older adults has been conducted using single-component exercise interventions that primarily target strength (Miller, Crotty, Whitehead, Bannerman, & Daniels, 2006; Morgan, 2005; Sullivan, Roberson, Smith, Price, & Bopp, 2007),

and address select populations with chronic disabilities (Clemson et al., 2004; Hirsch, Toole, Maitland, & Rider, 2003; Murphy et al., 2008). Prevention of disability and improved function are common goals of most research on this topic, but are often arbitrarily defined and lack consistent definition (Fisher, 1992; Jette & Haley, 2005). Outcomes are of a broad range, with function being most frequently assessed through physical performance (Baker, Atlantis, & Fiatarone Singh, 2007; Chin A Paw, van Uffelen, Riphagen, & van Mechelen, 2008), leaving a limitation in understanding the impact of older adult exercise on performance difficulty, performance satisfaction, and participation in activities of daily living (ADL; ACSM et al., 2009; Keysor & Jette, 2001).

Presently, there is no gold standard for determining the effectiveness of multi-component exercise and physical activity programs for older adults. To increase physical activity as a health promotion effort for the general, older adult population, a better understanding of how best practice, multi-component exercise and physical activity programs impact independence and participation in daily living for community-dwelling seniors is imperative.

1.2 PURPOSES OF DISSERTATION

There are two primary aims of this dissertation:

Aim 1: Evaluate and synthesize the current literature on group-based, multi-component exercise and physical activity programs for community-dwelling, older adults.

Aim 2: Evaluate the effect of participation of sedentary, community-dwelling older adults from low-income households in the First Step to Active Health (FSAH), a best practice exercise and physical activity program, on physical activity, ADL performance, physical performance, and depression.

1.3 ORGANIZATION OF DISSERTATION

This dissertation is presented in four chapters. Chapter one provides an introduction on the importance of exercise and physical activity for older adults, defines best practice, and outlines the content of the remaining chapters. Chapter two is a systematic review of the literature. The systematic review evaluated and synthesized 15 research studies that investigated the impact of group-based, multi-component, exercise and physical activity programs for older adults living in the community. Outcome constructs for determining effectiveness of these programs included: physical performance, physical activity, ADL, quality of life, depression, and self-efficacy. Chapter three of this dissertation is the report of a pretest, posttest, post-posttest cohort study, conducted to examine the effect of participation in a group-based, multi-component exercise and physical activity program (FSAH) with sedentary, community-dwelling older adults from low income households. Chapter four summarizes the findings of this dissertation and discusses future research needs in relation to best practice exercise and physical activity programs for older adults.

2.0 A SYSTEMATIC REVIEW OF THE LITERATURE

2.1 INTRODUCTION

The health promotion benefits of increased physical activity for older adults are well documented (Abbott et al., 2004; Buchner et al., 1992; Fiatarone et al., 1994; Seguin & Nelson, 2003). In addition to its impact on health, physical activity has been correlated with reduced healthcare costs, prevention of frailty, and increased quality of life (Ackerman et al., 2008; Courtney et al., 2009; Peterson et al., 2009). Despite the evidence, most adults do not engage in sufficient levels of regular exercise or physical activity to provide a health benefit (Rhodes et al., 1999). Inactivity has been recognized internationally as a public health concern and strategies have been initiated within the United States and abroad to address this issue (U.S. Department of Health and Human Services, 2008; World Health Organization, 2010). While physical activity levels are low for the general adult population, older adults are even less likely to engage in physical activity (Agency for Healthcare Research and Quality, 2002; Kruger et al., 2007). Real barriers such as poor health and unsupportive physical environments, as well as perceived barriers such as decreased self-efficacy and social myths regarding exercise, all affect older adult participation in physical activity (Boyette et al., 2002; Brawley, Rejeski, & King, 2003; Burbank & Riebe, 2002; Schutzer & Graves, 2004). With an aging population being one of the most significant trends affecting healthcare costs and global health, increasing physical activity in older adults has

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In 2004, the American College of Sports Medicine (ACSM) created best practice guidelines for increasing physical activity for older adults. These guidelines recommend multi-component exercise programs that are group-based and incorporate behavioral change strategies. Updates on this position by the ACSM et al. (2009), the American Heart Association (Nelson et al., 2007) and guidelines published by the U.S. Department of Health and Human Services (U.S. DHHS, 2008) recommend that older adults regularly participate in multi-component physical activity programs that address endurance, strength, flexibility, and balance for those with increased falls risk or mobility limitations. Despite these recommendations, most research on physical activity and exercise for older adults has been conducted using single-component exercise interventions that primarily target strength (Miller et al., 2006; Morgan, 2005; Sullivan et al., 2007), and address select populations with chronic disabilities (Clemson et al., 2004; Hirsch et al., 2003; Murphy et al., 2008). Prevention of disability and improved function are common goals of most research on this topic, but are often arbitrarily defined and lack consistent definition (Fisher, 1992; Jette & Haley, 2005). Outcomes are of a broad range, with function being most frequently assessed through physical performance (Baker, Atlantis, et al., 2007; Chin A Paw et al., 2008). Function is also often assessed through the frequency, intensity, duration and type of physical activity (Tudor-Locke & Myers, 2001). Unfortunately, physical performance and physical activity measures limit our understanding of the impact of older adult exercise on performance difficulty, performance satisfaction, and participation in daily living. (ACSM et al., 2009; Keysor & Jette, 2001). An examination of how this research relates to recommendations by the ACSM and guidelines offered by the U.S. Department of Health and

Human Services is critical to the development of successful physical activity programs for older adults, and is the objective of the current study.

2.2 METHOD

A literature review was completed to identify research implementing group-based, multi-component exercise interventions for improving physical activity levels or function in older adults. Of primary interest were public health approaches targeting the general population of community-dwelling, sedentary, older adults.

2.2.1 Search Strategy

An electronic search of Ovid MEDLINE, CINAHL and ISI Web of Science databases was used to locate studies. In light of the recent increase in research regarding the general health benefits of physical activity, this search was limited to studies published from 1998 to August 2010. Primary search terms were: (a) older adult, (b) physical activity, and (c) exercise. Secondary search terms were: (a) multi-component exercise, (b) multi-dimensional exercise, (c) multi-modal exercise, and (d) group. The primary search term *older adult* was combined with each of the other primary search terms separately, and then all three terms were combined. Each primary search term combination was also combined with each secondary search term. Through a review of abstracts, studies were considered if they were quantitative, published in English, and included at least 3 of the following components in the intervention: endurance, strength, flexibility, and balance. These studies were then reviewed and included if they met the following inclusion

criteria: group-based in format, addressed a general population versus a population with a specific medical condition, included both males and females, and targeted persons age 50 years or older. In addition to studies identified through the aforementioned databases, the reference lists of the articles meeting criteria were reviewed for potential studies. Recommendations from expert resource persons were also considered.

2.2.2 Procedure

For those studies meeting the inclusion criteria, the following data were extracted using a structured format (Table 2.1): study design, objective, sample size, location of intervention delivery, frequency, duration, outcome measures, and results. The quality of evidence for each study was determined using a five level hierarchy (Moore, McQuay & Gray, 1995). These data were then used to compare studies from the perspective of the ACSM best practice guidelines and impact on function and participation in daily living.

2.3 RESULTS

The electronic search generated 1082 potential articles, with an additional 51 articles identified through other sources, including reference citations. Two systematic reviews of multi-component exercise programs designed for use with older adults were identified, yielding 40 potential studies (Baker, Atlantis, et al., 2007; Chin a Paw et al., 2008) and two studies were identified through an expert resource (See Figure 2.1).

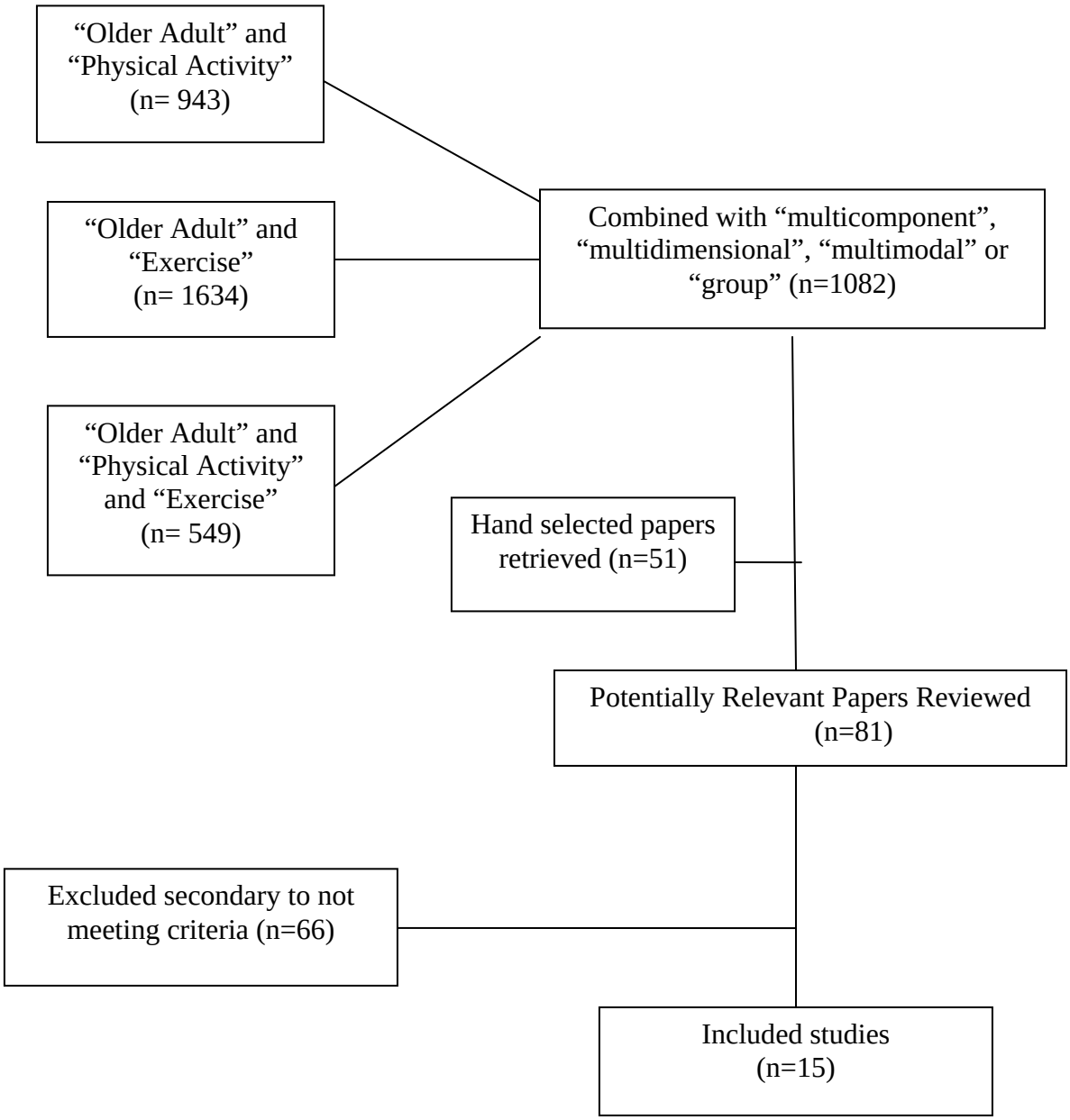

Figure 2:1 Flow of studies considered for review

Fifteen studies were identified as meeting the search criteria for this review; they are listed in chronological order in Table 2.1. There were 12 randomized controlled trials and three studies employing a quasi-experimental design. Although the search criterion was from 1998 through August, 2010, only one study was published before 2001 (Wallace et al., 1998). All but four studies (Binder et al., 2002; Lord et al., 2003; Wallace et al., 1998; Worm et al., 2001) were published after the 2004 development of the ACSM best practice guidelines for older adult physical activity programs. Twelve studies met the criteria for Level II evidence, with the remaining three studies reporting Level III evidence. The following is a summary of the evidence in terms of population, intervention, outcomes, adherence, retention, and sustainability.

Table 2.1 Description of the Study Objectives, Interventions, and Outcomes

Study	Design	Objective	Sample	Location	Frequency	Duration	Outcome Measures	Significant Results
Wallace et al. 1998	RCT	Evaluate a cost-effective and practical disability prevention program	*N* = 100	Senior Center	60 min 3x per week	6 months	PA: *Restricted activity days and bed days* QOL: *SF-36* Depression: *CES-D*	(+) for 7/8 SF-36 subscales (+) CES-D
Worm et al. 2001	RCT	Determine effect of exercise program on function and strength to reduce frailty	*N* = 46	Training site	60 min 2x per week	12 weeks	PP: *Berg balance scale, 10 m walking test, max contraction shoulder abductors* QOL: *SF-36*	(+) for all measures
Binder et al. 2002	RCT	Determine effect of exercise program on frailty	*N* = 115	Exercise facility	3x per week	9 months	PP: *Modified PPT, VO2 max, knee strength, Berg balance scale, single limb stance* QOL: *SF-36* ADL: *FSQ, OARS ADL*	(+) PPT, VO2 max, knee strength, single limb stance (+) SF-36 (+) FSQ
Lord et al. 2003	RCT	Determine effect of exercise program on frailty and physical function	*N* = 551	Retire-ment village	60 min 2x per week	12 months	PP: *Stepping reaction time, hand reaction time, 6 minute walk, knee strength, postural sway, leaning balance* ADL: *Falls incidence*	(+) Stepping and hand reaction time, 6 minute walk (+) Falls decrease for those with history of falls

Study	Design	Objective	Sample	Location	Frequency	Duration	Outcome Measures	Significant Results
Toraman et al. 2004	RCT	Evaluate effect of exercise program on functional fitness	*N* = 42	Retire-ment home	3x per week	9 weeks	PP: *SFT*	(+) 4/6 SFT measures
Belza et al. 2006	Quasi-experi-mental	Assess effectiveness of Enhance Fitness on physical performance, health status and falls	*N* =1258 (4 months) *N* = 880 (8 months)	Multiple locations	60 min 3x per week	8 months	PP: *SFT (modified)* QOL: *SF-12*	(+) 2/3 SFT measures at 4 month and 8 month for persons with baseline WNL; 3/3 for persons with baseline BNL
The LIFE Study Investi-gators et al. 2006	RCT	Assess effect of a physical activity intervention on physical performance	*N* = 397	Training centers (4 sites)	40-60 min 3x per week + 1 hr behavioral counseling group (phase1) 2x per week (phase 2) 1-2x week (phase 3)	12 months	PP: *SPPB, 400 m walk speed* PA: *CHAMPS*	(+) for all measures

Study	Design	Objective	Sample	Location	Frequency	Duration	Outcome Measures	Significant Results
Baker et al. 2007	RCT	Evaluate effectiveness of best practice on exercise capacity, functional limitations, and health	*N* = 38	Retire-ment village	60-90 min 3x per week (strength) 2x per week (aerobic) 1x per week (balance)	10 weeks	PP: *One-repetition max strength, 6 minute walk, habitual gait velocity, chair stand, stair climb, static/dynamic balance*, SPPB PA: *PASE* Depression: *GDS* Self-Efficacy: *Ewart Physical SE scale*	(+) one-repetition max strength for chest press and right hip flexion and abduction
Fahlman et al. 2007	RCT	Assess impact of structured exercise on limitations in function	*N* = 73	Univer-sity training center	1x per week (group) 2x per week (home exercise program)	16 weeks	PP: *6 minute walk, UE/LE strength, stair test, chair stand, bicep curl, time on and off the floor*	(+) UE extension, chair stand and bicep curl
Opden-acker et al. 2008	RCT	Compare home-based and group-based interventions on physical activity	*N* = 186	Fitness center	60-90 min 3x per week	11 months	PA: *Pedometer, accelerometer, FPACQ*	(+) 3/4 FPACQ and steps per day (pedometer)

Study	Design	Objective	Sample	Location	Frequency	Duration	Outcome Measures	Significant Results
Resnick et al. 2008	RCT	Testing a self-efficacy intervention for use with minorities	*N* = 166	Senior centers	60-90 min 2x per week	12 weeks	PP: *Tinetti, chair rise* PA: *YPAS* QOL: *SF-12, fear of falling, NRS (pain)* Depression: *GDS* Self-Efficacy: *SEE,OEE*	(+) OEE and GDS
Hughes et al. 2009	RCT	Assess impact of recognized best practice program	*N* = 544	Multiple locations	60 min 3x per week	10 months	PP: *Sit to stand, arm curl, back scratch, 6 minute walk, body mass index* PA: *CHAMPS (exercise adherence)* QOL: *SF-36* Depression: *CES-D* Self-Efficacy: *SEE, OEE, SE for exercise adherence in face of barriers, SE for adherence over time*	(+) sit to stand, arm curls, SEE, SE for exercise adherence in face of barriers, SE for adherence over time
Moore-Harrison et al. 2009	Quasi-experi-mental	Examine feasibility and outcome of exercise program in centers with meal programs	*N* = 31	2 Senior centers that provide congre-gate meals	60 min 3x per week	12 weeks	PP: *SFT* QOL: *SF-36*	(+) 4/6 SFT and 3/8 SF-36 subscales

Study	Design	Objective	Sample	Location	Frequency	Duration	Outcome Measures	Significant Results
Yan et al. 2009	Quasi-experi-mental	Measure effect of Active Start on physical performance	*N* = 156	Senior centers	45-60 min 1x per week (4 weeks-education) 3x per week	24 weeks	PP: *SFT*	(+) 6/6 SFT
Van Roie et al. 2010	RCT	Compare group and home-based interventions on fitness and cardiovascu-lar factors	*N* = 175	Fitness Center	60-90 min 5 sessions per 2 weeks	11 months	PP:*VO2 max and exhaustion, peak workload, max isometric and dynamic torque right leg, knee strength endurance, arm curl, chair stand, vertical jump*	(+) for all measures

Note. RCT = randomized controlled trial; PA = physical activity; QOL = quality of life; SF-36 = Medical Outcomes Study Short Form-36; CES-D = Center for Epidemiologic Studies Depression Scale; PP = physical performance; PPT = Physical Performance Test; VO2 = oxygen consumption; max = maximum; ADL = activities of daily living; FSQ = Functional Status Questionnaire; OARS = Older Adult Resource and Services; SFT = Senior Fitness Test; SF-12 = Medical Outcomes Study Short Form-12; WNL = within normal limits; BNL = below normal limits; SPPB = Short Physical Performance Battery; CHAMPS = Community Healthy Activities Model Program for Seniors; PASE = Physical Activity Scale for the Elderly; GDS = Geriatric Depression Scale; SE = self-efficacy; UE = upper extremity; LE = lower extremity; FPACQ = Flemish Physical Activity Computerized Questionnaire; YPAS = Yale Physical Activity Survey; NRS = Numeric Rating Scale; SEE = self-efficacy for exercise; OEE = outcomes expectation for exercise.

2.3.1 Population and Settings

Nine studies were conducted in the United States, while the remaining six were conducted in Australia, Belgium, Denmark, or Turkey. All studies took place in the community. Only Moore-Harrison, Johnson, Quinn and Cress (2009) and Resnick, Luisi, and Vogel (2008), by virtue of intervention location (i.e., congregate meal sites serving low-income seniors and senior centers in low-income public housing developments), targeted a population based on socioeconomic status. Four studies were conducted only in senior centers (Moore-Harrison et al., 2009; Resnick, Luisi, et al., 2008; Wallace et al., 1998; Yan, Wilber, Aguirre, & Trejo, 2009), while Hughes, Seymour, Campbell, Whitelaw, & Bazzarre (2009) selected three contrasting sites that provided group exercise for older adults - a senior center, school and hospital in their effort to broadly examine best practice programming. Findings from Belza et al. (2006) reflect national outcomes for the Enhance Fitness Program covering nine states and 116 groups, which were conducted in a variety of places ranging from churches to the YMCA. Two programs conducted their interventions at the site of the subjects' residence (Baker, Kennedy, et al., 2007; Lord et al., 2003) and the remainder of studies delivered the intervention at either a fitness facility or a designated training center (Binder et al., 2002; Fahlman, Topp, McNevin, Morgan, & Boardley, 2007; LIFE Study Investigators et al., 2006; Opdenacker, Boen, Coorevits, & Delecluse, 2008; Toraman, Erman, & Agyar, 2004; Van Roie et al., 2010; Worm et al., 2001).

All studies recruited from a general community population. Three studies were designed to target frail older adults using criteria such as location of residence (Lord et al., 2003), need for an assistive ambulatory device (Worm et al., 2001), and probability of mortality and future disability (Binder et al., 2002) as a qualification for frailty. Given that the current, common

criteria for frailty requires the presence of multiple physiological conditions (Fried et al., 2001), this research was still included in this review. Several studies recruited subjects from a "contained" population living in a retirement home or community (Baker, Kennedy, et al., 2007; Lord et al., 2003; Toraman et al., 2004). Despite the fact that all participants were living on the campus of the targeted setting and intervention site, two of these studies (Baker, Kennedy, et al., 2007; Lord et al., 2003) had problems with recruitment and/or retention, suggesting that location alone is not a determinant of success.

Sample size was determined through a power analysis in five studies (Baker, Kennedy, et al., 2007; Hughes et al., 2009; LIFE Study Investigators et al., 2006; Opdenacker et al., 2008; Van Roie et al., 2010). Overall, sample sizes ranged from $N = 31$ (Moore-Harrison et al., 2009) to $N = 1258$ (Belza et al., 2006). With the exception of Hughes et al. (2009), all studies targeted persons age 60 or older, with a combined average participant age of 75.7 years. Hughes et al. reported an average age of 65.7 with a range of 50 to 88 years of age. As 47% of the participants were under the age of 65 and only of middle age, the findings of Hughes et al., in relation to older adults, were interpreted with caution. In 13 of the 15 studies, the majority of participants were female. Such statistics are not surprising, given current demographic trends that support a longer life expectancy for women than men (Kinsella & Velkoff, 2001).

2.3.2 Intervention

The initial ACSM publication of best practice guidelines recommended that multidimensional activity programs include endurance, strength, flexibility, and balance for optimal functional benefits for older adults (ACSM, 2004; Cress et al., 2005). Based on further evidence,

subsequent updates from ACSM and other guidelines recommend multidimensional activity programs include endurance, strength, flexibility, and balance as indicated for the specific older adult population (ACSM et al., 2009; U.S. DHHS, 2008). Nearly all the studies reviewed incorporated the four recommended exercise types (Belza et al., 2006; Binder et al., 2002; LIFE Study Investigators et al., 2006; Lord et al., 2003; Moore-Harrison et al., 2009; Opdenacker et al., 2008; Van Roie et al., 2010; Wallace et al., 1998; Worm et al., 2001; Yan et al., 2009). For the remaining studies, balance was the component most often omitted. Three studies included a home program as a component of the exercise-based intervention (Fahlman et al., 2007; LIFE Study Investigators et al., 2006; Worm et al., 2001). Fahlman et al. (2007) and Worm et al. (2001) introduced a home program at the beginning of the intervention as part of the group-based exercise protocol. LIFE Study Investigators et al. (2006) gradually introduced their home program after 24 weeks, as a strategy for transitioning to a maintenance phase, while reducing participation in the group-based exercise portion of the intervention.

Less than half the studies incorporated behavioral change strategies as a component of the exercise and physical activity intervention (LIFE Study Investigators et al., 2006; Resnick, Luisi, et al., 2008; Wallace et al., 1998; Yan et al., 2009). Self-efficacy was the primary intervention focus of Resnick, Luisi, et al. (2008), whereas LIFE Study Investigators et al. (2006) and Yan et al. (2009) introduced behavioral change activities heavily in the beginning of the intervention, tapering off over time. Wallace et al. (1998) used behavioral change strategies to enhance adherence for group exercise. Results of these studies compared to those that did not employ behavioral change activities as part of their exercise intervention group demonstrate no remarkable differences. In the study by Opdenacker et al. (2008) comparing the effect of two different intervention approaches for increasing physical activity in older adults, however, results

were more significant. As part of their intervention design, behavioral changes activities were provided only to the lifestyle intervention group and not to the structured exercise intervention group, with long-term results favoring physical activity gains only for the lifestyle intervention group.

All the published studies addressed safety, the final determinant of *best practice*, through their subject inclusion/exclusion criteria and program designs that began with lower intensity exercises and a gradual increase in difficulty, based on tolerance by the participants and design of the protocol. None of the studies reported serious adverse effects from participating in a group exercise program, which supports national guidelines that recommend exercise as a health promotion option for all ages.

Studies shared similarities in frequency and duration of group sessions, with exercises completed 1-3 times per week, and length of sessions generally ranging from 45 to 90 minutes. With the exception of Baker, Kennedy, et al. (2007) and Binder et al. (2002), the studies incorporated all exercise components included in the protocol during each exercise session. Baker, Kennedy, et al. divided the components so as to consistently provide strengthening exercise paired with either endurance or balance activities for each session. Binder et al. phased in each exercise component over 9 months, beginning with flexibility and balance, followed by strength and then endurance. For the remaining studies, multi-component sessions included a warm-up of light aerobic activity and flexibility, a core component of endurance and strengthening activities, and balance or flexibility, usually as a cool-down.

Several of the studies only included limited protocol information (Hughes et al., 2009; Lord et al., 2003; Moore-Harrison et al., 2009; Toraman et al., 2004; Wallace et al., 1998; Worm et al., 2001). For those studies providing greater detail, the mode of exercise program delivery

varied greatly. Some of the protocols incorporated specialized exercise machines, such as treadmills, recumbent steppers and isokinetic strength stations (Baker, Kennedy, et al., 2007; Binder et al., 2002; Opdenacker et al., 2008, Van Roie et al., 2010), whereas other programs used lower cost equipment, such as exercise bands, cuff weights, and exercise videotapes or disks (Belza et al., 2006; Fahlman et al., 2007; LIFE Study Investigators et al., 2006; Resnick, Luisi, et al., 2008; Yan et al., 2009). Binder et al. (2002) reported significant gains on 4 of 5 physical performance measures using high cost exercise equipment; however, Baker, Kennedy et al. (2007) reported significant gains on only 1 of 4 physical performance measures using similar equipment. Fahlman et al. (2007) and Yan et al. (2009) introduced strength training through use of low cost resistance bands to produce significant gains in 3 of 9 and 6 of 6 physical performance measures, respectively, whereas the protocol by Resnick, Luisi, et al. (2008) used resistance bands without realizing any significant changes in physical performance.

Interventions ranged from 9 weeks to 12 months, which was consistent with published reviews examining older adult exercise programs (Baker, Atlantis, et al., 2007; Keysor & Jette, 2001). Two studies with intervention programs of 6 months or longer reported significant gains in physical activity using standardized measures (Hughes et al., 2009; Opdenacker et al., 2008). In contrast, Wallace et al. (1998) completed a 6 month intervention with no significant results, but used a non-standardized method of assessment. Two studies of shorter duration produced mixed results regarding gains in physical activity levels (Baker, Kennedy, et al., 2007: Resnick, Luisi, et al., 2008). Baker, Kennedy, et al. (2007) conducted a 10 week study with a lower than anticipated sample size that may not have had sufficient power to detect a significant change. The 12 week study by Resnick, Luisi, et al. (2008) produced significant gains in exercise-related physical activity levels despite an intervention that primarily targeted self-efficacy training, with

multi-component exercise as a secondary component. Two studies with significant physical performance outcomes were shorter programs of 9 and 12 weeks duration, with both using the Senior Fitness Test as their outcome measure (Moore-Harrison et al., 2009; Toraman et al., 2004).

2.3.3 Outcomes

Despite all 15 studies addressing a general, older adult population, the primary study objectives often differed. Several studies examined the effect of multi-component exercise intervention on persons considered to be frail (Binder et al., 2002; Lord et al., 2003; Worm et al., 2001), whereas impact on physical performance was the primary interest for others (Fahlman et al., 2007; LIFE Study Investigators et al., 2006; Toraman et al., 2004; Yan et al., 2009). Belza et al. (2006) examined the effectiveness of the Enhance Fitness program on function and health; Moore-Harrison et al. (2009) subsequently assessed the feasibility of implementing the Enhance Fitness program in a congregate-meal site serving low-income seniors. Self-efficacy training was the target of work by Resnick, Luisi, et al. (2008), and two studies (Opdenacker et al., 2008; Van Roie et al., 2010) compared structured multi-component exercise versus lifestyle redesign on changes in physical activity behavior and health. The efficacy and feasibility of best practice guidelines in general older adult populations was examined by Baker, Kennedy, et al. (2007), whereas Hughes et al. (2009) assessed the impact of existing best practice physical activity programs on physical activity participation and health-related outcomes. Disability prevention was the primary outcome of the study by Wallace et al. (1998).

Outcome measures are usually selected for their ability to document change related to a study's primary objective. Because of the wide range of objectives, which expanded beyond

physiological capacity to target disability prevention, reduced frailty, and enhanced self-efficacy, the number and type of outcome measures varied greatly for each study identified in this review. Primary outcome constructs included: (a) physical performance, (b) physical activity, (c) ADL, (d) quality of life, (e) depression, and (f) self-efficacy. Regardless of the target outcome, physical performance was evaluated with objective measures in all but two studies (Opdenacker et al., 2008; Wallace et al., 1998). Outcome tool selection for this construct varied widely, with the Senior Fitness Test (Rikli & Jones, 2001) being the most commonly used measure. Of those studies that included physical performance as an outcome, all but one study (Resnick, Luisi, et al., 2008) reported significant improvement in at least one performance component or measure. Six studies included self-report measures of physical activity (Baker, Kennedy, et al., 2007; Hughes et al., 2009; LIFE Study Investigators et al., 2006; Opdenacker et al., 2008; Resnick, Luisi, et al., 2008; Wallace et al., 1998) but only four reported significant gains, and none used the same self-report tool. The self-report physical activity measures selected by Hughes et al. (2009) and Opdenacker et al. (2008) revealed statistically significant gains in the frequency and amount of physical activity, and Resnick, Luisi, et al. (2008) noted significantly increased levels of exercise in their subjects. Additionally, Opdenacker et al. also examined change in physical activity with objective measures using accelerometers and pedometers. In contrast to the results of the self-report tools, these physical activity measures did not detect significant changes in the exercise intervention group.

Unlike physical performance and physical activity, the remaining outcome constructs were not consistently measured. ADLs were addressed in two studies. Binder et al. (2002) examined difficulty in ADL performance using two self-report measures, and noted a significant improvement on the Functional Status Questionnaire (FSQ; Jette & Cleary, 1987) but no change

on the Older Adult Resources and Services instrument (OARS; Fillenbaum & Smyer, 1981). Lord et al. (2003) took a more restricted approach to examining ADL performance by measuring ADL-related falls and noted a significant decrease for those subjects who had a history of falls but not for those without a falls history. Change in quality of life (QOL), as measured by the Medical Outcomes Study Short Form (SF-36; Ware & Sherbourne, 1992), was found to be significant in four studies (Binder et al., 2002; Moore-Harrison et al., 2008; Wallace et al., 1998; Worm et al., 2001). In contrast, Hughes et al. (2009) did not report significant findings for QOL using the SF-36, nor did Belza et al. (2006) or Resnick, Luisi, et al. (2008) using an shortened version of the same tool (SF-12; Ware, Kosinski, & Keller, 1996). Self-efficacy was used as an outcome measure in three studies (Baker, Kennedy, et al., 2007; Hughes et al., 2009; Resnick, Luisi, et al., 2008). Baker, Kennedy, et al. (2007) reported no change in exercise self-efficacy, but Hughes et al. demonstrated that self-efficacy for exercise, self-efficacy of exercise adherence over time, and self-efficacy in the face of barriers significantly improved over the course of 10 months. Outcome expectations for exercise are influenced by self-efficacy (Resnick, 2001). While the 12 week study by Resnick, Luisi, et al. did not produce change in self-efficacy for exercise, they did observe a significant increase in the subjects' outcome expectations for exercise. Hughes et al. in contrast, reported no significant change on this same measure. The last primary construct, depression, was an outcome variable in four studies (Baker, Kennedy, et al., 2007; Hughes et al., 2009; Resnick, Luisi, et al., 2008; Wallace et al., 1998), but only Resnick, Luisi, et al. and Wallace et al. (1998) reported significant reductions in depressive symptoms following participation in the intervention.

2.3.4 Retention and Adherence

Despite evidence suggesting low participation rates by older adults in exercise and physical activity programs (Chao, Foy, & Farmer, 2000), most of the studies reported high rates of retention and adherence. With the exception of the study by Lord et al. (2003) with a 43% adherence rate, smaller studies and studies with interventions conducted at a limited number of locations reported adherence rates ranging from 77% to 100% (Baker, Kennedy, et al., 2007; Binder et al., 2003; Moore-Harrison et al., 2009; Opdenacker et al., 2008; Resnick, Luisi, et al., 2008; Toraman et al., 2004; Van Roie et al., 2010; Wallace et al., 1998; Worm et al., 2001; Yan et al., 2009). Larger studies reflecting participation in pre-established programs that incorporated best-practice exercise measures across multiple intervention settings noted somewhat lower adherence levels (Belza et al., 2006; Hughes et al., 2009). The combined average rate of retention for all subjects participating in a multi-component exercise intervention for all studies in this review was 79%, with individual study retention rates ranging from 64% (Resnick, Luisi, et al., 2008) to 100% (Toraman et al., 2004).

2.3.5 Sustainability

One of the concerns regarding physical activity programs for older adults is sustainability. Only 2 of the 15 studies considered the long-term effects of its intervention. Using a three group design, Opdenacker et al. (2008) evaluated the short-term and long-term effects of a group-based exercise program versus a lifestyle design group against a control group. Outcomes were measured at the conclusion of the study and then 12 months later. Results demonstrated that both interventions were effective in the short-term for demonstrating gains in health and function, but

only the lifestyle design group, whose intervention included behavioral change activities, sustained gains in physical activity over time. The LIFE-P study by LIFE Study Investigators et al. (2006) introduced an intervention intentionally designed to address sustainability by transitioning participants from 24 weeks of a structured group program with supervision to 28 additional weeks of a more independent program for increased physical activity. At the 12 month post-test, significant results were noted for all measures.

2.4 DISCUSSION

Despite the guidelines and recommendations supporting multi-component exercise and physical activity programs for older adults (ACSM, 2004; ACSM et al., 2009; U.S. DHHS, 2008), this review revealed several gaps in knowledge and research design limitations that impact the translation of current evidence into practice.

Foremost, the amount of research examining best practice physical activity programs for the general population of community-dwelling, older adults is minimal. After eliminating all studies targeting older populations with specific acute or chronic health conditions, our search yielded only 15 studies that addressed the exercise and physical activity needs of seniors at a general, community-based health level. While all studies in our review included a multi-component, group-based intervention, only four studies incorporated behavioral change strategies as part of the exercise and physical activity intervention (LIFE Study Investigators et al., 2006; Resnick, Luisi, et al., 2008; Wallace et al., 1998; Yan et al., 2009), thereby addressing all of the elements which define best practice programming (ACSM, 2004).

Each of the exercise and physical activity interventions resulted in significant improvement for one or more outcome measures. While most participants experienced gains in physical performance, no clear trends were evident for the other outcomes. Despite autonomy, independence, and the ability to live in the community being directly dependent on ADL function (Leveille, Fried, McMullen, & Guralnik, 2004; Pennix et al., 2001; Phelan, Williams, Pennix, LoGerfo, & Leveille, 2004), only two studies measured ADL performance. Function was most frequently assessed through change in physical performance, followed by quality of life and physical activity. Coster et al. (2004) cited the complexity of ADL performance and limitations of ADL measures as rationale for its limited inclusion as a functional outcome. However, the current lack of evidence supporting a simple, direct relationship between factors such as physical performance, physical activity, quality of life, and the ability to complete ADLs (ACSM et al., 2009) affirms the critical importance of including multiple outcome constructs, especially ADL performance, for determining the effectiveness of best practice exercise and physical activity programs for older adults.

This review demonstrated few patterns linking a specific intervention protocol to successful results. Studies reported significant improvements both with and without the inclusion of behavioral change strategies. Gains in performance were realized, regardless of the cost and type of exercise equipment or exercise intensity levels. With the exception of Fahlman et al. (2007) and LIFE Study Investigators et al. (2006) who supplemented a home exercise program in lieu of group-based sessions, all intervention protocols included a minimum of two group sessions per week, with each session averaging one hour. Intervention durations varied greatly between the studies, and positive outcomes were achieved with studies as short as 9 weeks and as long as 12 months.

Low participation in exercise and physical activity by older adults is largely attributed to barriers, both real and perceived. None of these studies specifically focused on the reduction of barriers to enhance adherence and promote retention, yet the average participation rates for these studies was inexplicably high. Volunteer bias or similar confounding variables must be more closely examined as factors that could potentially limit the applicability of these findings to the general population of older adults.

This review adds to the current body of knowledge supporting best practice exercise and physical activity interventions for older adults. Based on this review, a need exists for more research that incorporates all components of the best practice guidelines and also includes ADL performance as one of the outcomes evaluating the effect of the interventions on function. Frequency, intensity, duration, and mode of exercise delivery must be more carefully and systematically manipulated to better determine if these factors impact results. Common barriers experienced by the general population of older adults must be considered in order to determine the applicability of an exercise and physical activity intervention for use in community health programs. Only through a better understanding of how these components affect health and participation for older adults will we be able to positively affect the health promotion needs of this growing population.

3.0 RESEARCH STUDY

3.1 INTRODUCTION

Participation in physical activity is an evidence-based strategy for improving health in older adults (Buchner et al., 1992; Fiatarone et al., 1994; Warburton, Nicol, & Bredin, 2006). In addition to physiological benefits such as decreased blood pressure, preserved bone density, and increased cardiovascular endurance, engaging in physical activity and exercise impacts other key health areas including reducing the risk of dementia and lessening the effects of depression (Abbott et al., 2004; Seguin & Nelson, 2003; Singh, Clements, & Singh, 2001; Thompson et al., 2003). Despite these findings, only a small percentage of older adults engage in sufficient levels of physical activity and exercise (Kruger et al., 2007). Commonly cited barriers to engagement in physical activity by older adults include low socioeconomic status, poor health, the necessary time commitment, unsupportive physical environments, and preconceived negative notions regarding the concept of "exercise" (Boyette et al., 2002; Brawley et al., 2003; Burbank & Riebe, 2002; Schutzer & Graves, 2004). When barriers such as cost, transportation, access to equipment and medical clearance for health conditions are resolved, however, long-term adherence rates to sustain increased activity levels in older adults are still often poor (Chao, Foy, & Farmer, 2000). With international statistics predicting a population explosion for the age group 65 years and older (Administration on Aging, 2009; Kinsella & Velkoff, 2001), facilitating increased levels of

engagement in physical activity as a health promotion effort for older adults has become a public health concern and an economic imperative (Ackerman et al., 2008; Courtney et al., 2009; King et al., 1998).

A best practice Position Stand from the American College of Sports Medicine (ACSM; 2004; ACSM et al., 2009), recommendations from the American Heart Association (Nelson et al., 2007), and physical activity guidelines by the U.S. Department of Health and Human Services (U.S. DHHS, 2008) were recently published to help address this pressing issue. These documents recommend that older adults regularly engage in multi-component physical activity programs that include exercise targeting aerobic capacity/endurance, strength, flexibility, and balance for those with mobility problems or at risk for falls. The ACSM suggests group-based programs over individual programs, and the incorporation of behavioral change principles as critical elements for initiating and maintaining physical activity in older adults. In addition to the development of these guidelines, the ACSM has partnered with several other professional organizations to create and endorse an Active Aging Toolkit. Developed to assist healthcare providers in promoting the benefits of physical activity, this toolkit includes a scientifically-based, low-cost, progressive, multi-component exercise program titled the First Step to Active Health (FSAH; Human Kinetics, 2004; Page et al., 2004).

Despite guidelines, toolkits, programs like the FSAH, and evidence documenting the positive effect of physical activity on health, the direct impact of exercise and physical activity on life participation and engagement in activities of daily living (ADLs) for older adults is still not well understood (ACSM et al., 2009; Keysor & Jette, 2001). Improvement in function is a commonly used rationale for increasing physical activity levels in older adults, but the term "function" is rarely defined and broadly interpreted (Fisher, 1992; Jette & Haley, 2005). ADL

performance is acknowledged as a critical measure of function, providing justification of disability status, affecting healthcare reimbursement, and serving as a primary determinant of long-term care placement (Coster et al., 2004; Guralnik, Fried, & Salive, 1996; Phelan et al., 2004). While improved function is routinely cited as a goal in exercise studies for older adults, it is most often defined and measured using constructs other than actual ADL performance (Keysor & Jette, 2001).

Although current recommendations support the use of multi-component exercise interventions for health promotion and disability prevention, most research on this topic has included only single-component exercise interventions, has focused on select older adult populations with chronic disabilities, and has measured outcomes other than ADL performance (Clemson et al., 2004; Hirsch et al., 2003; Miller et al., 2006; Morgan, 2005; Murphy et al., 2008; Sullivan et al., 2007). An examination of the literature addressing group-based, multi-component physical activity interventions with a general, community-dwelling, older adult population of mixed gender resulted in the identification of 15 published studies (Baker, Kennedy, et al., 2007; Belza et al., 2006; Binder et al., 2002; Fahlman et al., 2007; Hughes et al., 2009; LIFE Study Investigators et al., 2006; Lord et al., 2003; Moore-Harrison et al., 2009; Opdenacker et al., 2008; Resnick, Luisi, et al., 2008; Toraman et al., 2004; Wallace et al., 1998; Worm et al., 2001; Yan et al., 2009; Van Roie et al., 2010). Additionally, a search for studies using the FSAH intervention with a well, older adult population yielded only one published abstract (Page, Boardley, & Topp, 2006). These studies varied widely in terms of number and type of outcome measures, setting, mode of exercise delivery, length of study, sample size, and effectiveness. Few interventions were designed to minimize common barriers or to include behavioral change strategies. Every study attempted to measure change in health and functioning

as a result of their intervention, yet only one study addressed function through a direct measurement of ADL performance (Binder et al., 2002). Such factors make it difficult to generalize the findings, and provide little information to help us understand how exercise and physical activity impact participation in daily life.

Presently, there is no gold standard for determining the effectiveness of multi-component exercise and physical activity programs for older adults. Research using multi-component exercise and physical activity programming with a general, older adult population is minimal, and does not comprehensively address all the features representing best practice. Function is most frequently defined as physical performance, focusing on client factors such as range of motion or strength, and leaving a gap in understanding the relationship between these components and participation in ADLs. Autonomy, independence, and the ability to participate in the community are recognized as constructs directly dependent on performance of ADLs (Leveille et al., 2004; Pennix et al., 2001; Phelan et al., 2004) and yet activity measures examining ADL function are rarely included. Recommended physical activity programs, such as the FSAH, have little to no published evidence supporting their endorsement.

The purpose of this study was to address some of these gaps and limitations in evidence through an intervention that has all the recommended components of best practice, and by including ADL performance as a functional outcome. Endorsed by the ACSM, the FSAH was selected because of its inclusion of best practice components, its low-cost design, and its self-assessment and goal-setting features linking the exercise program to ADL participation (Human Kinetics, 2004; Page et al., 2004). We focused our research on older adults from low-income households because their socioeconomic status presents more barriers and puts them at greater risk for sedentary behavior than the general older adult population (Boyette et al., 2002; Brawley

et al., 2003, Schutzer & Graves, 2004). This study attempted to eliminate those recognized barriers to engagement as it examined the effectiveness of an endorsed, low-cost, exercise and physical activity program. Our aim was to evaluate the effect of participation in a multi-component best practice exercise and physical activity program (FSAH) by sedentary, community-dwelling older adults from low-income households on physical activity, ADL performance, physical performance, and depression.

3.2 METHOD

A pretest, posttest, post-posttest cohort study was conducted to examine the effect of participation in a group-based, multi-component exercise and physical activity program using the FSAH with sedentary, community-dwelling older adults from low income households.

3.2.1 Participants

The trial was conducted at a large, low-income, senior public housing apartment building in the suburbs of Pittsburgh, PA. We targeted older adults from low income households because persons of low socioeconomic status are even less likely to be engaged in regular exercise than the general older adult population (Boyette et al., 2002). Demographics for this facility indicated a population that is 99% Caucasian, with an approximate 3:1 ratio of females to males. Participant inclusion criteria were permanent residency in the senior apartment building, age 60 years or older, able to ambulate independently (with or without an assistive device), no significant cognitive impairment (score of $\geq$ 5) on the 6-Item Screener (Callahan, Unverzagt,

Hui, Perkins, & Hendrie, 2002), and reported low levels of physical activity as measured by the Rapid Assessment of Physical Activity (scores of 1, 2 or 3 for the aerobic section and a score of 0 on the strength and flexibility sections; Topolsky et al., 2006). Exclusion criteria were recent hospitalization (6 months or less), reported current participation in a skilled physical therapy or occupational therapy rehabilitation program, current participation in a formal exercise program, lack of medical clearance, as needed, or presence of a health condition for which exercise is contraindicated (ACSM, 1998). All interested residents who met the criteria completed the Exercise and Screening for You (EASY) screening test (Resnick, Ory, et al., 2008). The EASY is a 6-item screening tool to identify individuals who might be at risk for adverse events if they participated in an exercise program. Persons who did not pass all items on the EASY were required to obtain physician approval prior to entering the study. Eligible participants provided written, informed consent. The University of Pittsburgh Institutional Review Board approved this study, which included a waiver of written informed consent to screen cognition, physical activity, and the potential need for medical clearance through use of the EASY.

3.2.2 Sample Size

Because of our interest in a comprehensive number of constructs that influence function, we did not select a primary outcome for this study. Results of the Yale Physical Activity Scale (YPAS) from an exercise intervention by Resnick (2002) were used to estimate the sample size. We selected the YPAS for sample size determination because of its focus on ADLs, and its use in research that shares a focus similar to our aim. The estimate was based on results for the treatment group only, before and after the intervention, and on the assumption that groups were independent. The effect size was adjusted as recommended by Cohen (1988, p. 49) to account

for the correlation between pretest and posttest scores in paired samples, and resulted in an adjusted effect size of .51. Given the adjusted effect size and a one-tailed significance level of .05, a sample of 27 participants was required to reach a power of 80%.

3.2.3 Intervention

The intervention followed the exercise and physical activity guidelines of the FSAH program. The FSAH was selected for use in this study because of its low-cost design, incorporation of self-efficacy enhancing activities, and inclusion of self-assessment and goal-setting features linking the exercise program to ADL participation. The 10 week intervention was conducted in the senior apartment building, and included group exercise sessions and a home exercise program. Group sessions incorporated key strategies for increasing self-efficacy including mastery experience/performance (e.g., acknowledgement and praise for proper execution of exercises), vicarious learning (e.g., group sessions and peer-led exercises), verbal encouragement/persuasion (e.g., praise and prizes), and awareness of normal physiological response through an understanding of normal responses to physical activity and self-monitoring (Bandura & Cervone, 1983; Resnick, Luisi, et al., 2008). Participants met for 60 minute group sessions, 2 times per week in a private room on the main floor of their building. They received a FSAH kit (Thera-band, Akron, Ohio), which provided written instructions on how to begin and sustain endurance, strength, flexibility, and balance exercises, exercise hints and safety reminders, an exercise log, a medium resistance exercise band, and a home exercise program with photographs of all exercises included in the group intervention. Group sessions were planned and supervised by the first author (PET), who is an occupational therapist, board certified in gerontology, and also certified as a group exercise professional by the American

Council on Exercise. Each session consisted of: a pre-exercise discussion, an exercise protocol, and a post-exercise discussion. During the first session, participants completed the FSAH self-assessment survey to identify potential areas of improvement related to daily living skills and to understand how specific types of exercise (i.e., endurance, strength, flexibility, balance) promote participation in specific daily activities. Results of the survey were referred to in each subsequent session during the pre-exercise discussion as a source of motivation and meaning for participation in the exercise program. Additional pre-exercise discussion topics were physical and psychological benefits of regular exercise and physical activity, strategies for exercising safely, and solutions for barriers to exercising. Participants were trained to self-monitor their performance of endurance and strengthening exercises using Borg's Rating of Perceived Exertion Scale (Borg, 1998), with a moderate exertion level goal of 12-13 on a scale ranging from 6 to 20 (Borg, 1998; Centers for Disease Control, n.d.). Large visual displays of the Borg scale were posted in the room, and instructions on use of the scale were reviewed at every session. Each week of the intervention had a theme (e.g., "Beat the Blues", "Trip to the Tropics") with appropriate decorations and props. Participants were encouraged to share ideas for planning future themes.

The FSAH exercise protocol began with a cardiovascular warm-up, followed by strength exercises, balance exercises, and a cool down that incorporated flexibility. With the exception of balance, nearly all exercises were completed while seated in a straight-back chair. Music that was age-appropriate and tied to the weekly theme was played during completion of the exercises to enhance mood. All exercises were demonstrated and led by the group instructor (PET), with the instructor supporting participants in co-leading components of the intervention. The protocol incrementally increased from 30 to 50 minutes over the 10 weeks, for safety and to maintain

target exertion levels. Endurance was addressed through the 5-10 minute warm-up, which incorporated large arm and leg movements, and followed a simple choreographed routine. The strengthening component consisted of 11 upper body and lower body exercises using a resistance band. Six balance activities were completed while standing with the support of a chair, and eight stretching exercises were completed during the cool-down. Progression was realized through increased duration, increased repetitions, increased resistance, and/or increased difficulty (e.g., transition from sitting to standing to complete exercises) over the 10 week intervention. Exercise modifications such as reduced duration, reduced number of repetitions, or use of an exercise band of less resistance were recommended as needed by the group instructor for individuals experiencing difficulty completing a specific exercise. Following the end of the second group session, participants were instructed to perform the exercise protocol by themselves, outside of the organized group sessions, an additional minimum of one time per week.

During the post-exercise discussions, participants received positive feedback on their efforts from the group leader and peers. Participants were encouraged to share examples of improvements in activities of daily living over the duration of the intervention. Strategies on ways to increase physical activity levels as part of a normal daily routine were regularly reviewed. Group celebrations involving light refreshments or giveaways (e.g., refrigerator magnets, t-shirts) for all participants were provided during one of the two weekly sessions. Questions regarding the home exercise program were answered during this time. Home exercise program adherence was tracked weekly through verbal report, and rewarded through eligibility for bi-weekly small prize drawings (e.g., plants, gift cards).

3.2.4 Treatment Fidelity

Observations by an external reviewer confirmed that the intervention protocol during group sessions matched that of the FSAH program manual at weeks 2, 6, and 10. This same external reviewer also observed completion of the home exercise program for a randomly chosen participant during weeks 6 and 10.

3.2.5 Measures

Participants completed a demographic questionnaire that included age, gender, ethnicity, marital status, and years of formal education, and a medical questionnaire identifying acute illnesses, chronic health conditions, and current medications.

Four outcome measures - 3 self-report tools and 1 observation-based tool- were used to evaluate effectiveness of the intervention. The Yale Physical Activity Survey (YPAS) is a self-report physical activity questionnaire that quantifies activity levels for select ADLs in a typical week over the past month (DiPietro, Caspersen, Ostfeld, & Nadel, 1993). It was developed for use with older adults. The YPAS consists of 40 items, divided into two sections and allows eight indices to be calculated. The first section examines performance in five categories expressed in hours per week: work, including homemaking tasks; yardwork; caregiving; exercise; and recreation. Scoring for the five categories is combined and reported as a total time summary in hours and a total energy expenditure summary expressed in kilocalories (kcals). The second section assesses intensity of activity participation for the following weighted index scores: vigorous activity, leisurely walking, moving, standing, and sitting. Scores are reported for each index, individually, and then combined for a total activity summary index. The YPAS has

demonstrated validity (DiPietro et al., 1993; Harada, Chiu, King, & Stewart, 2001; Starling, Matthews, Ades, & Poehlman, 1999) and 2 week repeatability (Pescatello, DiPietro, Fargo, Ostfeld, & Nadel, 1994). When compared to other self-report physical activity measures developed for older adults, the YPAS was the most sensitive in measuring overall levels of physical activity and includes more daily tasks in which older adults regularly engage (Resnick, King, Riebe, & Ory, 2008).

The Activity Measure-Post Acute Care (AM-PAC) is an activity limitations measure (Boston University, 2007). This self-report tool allows for the examination of perceived difficulty and level of assistance/limitations in three domains – Basic Mobility, Daily Activity, and Applied Cognition (Boston University, 2007; Haley, Coster, et al., 2004). Building on Item Response Theory (IRT), the AM-PAC is comprised of an item pool that combines items from existing instruments into one scale, and ranks them according to level of difficulty for each of the three domains (Haley, Andres, et al., 2004). IRT assumes that all items within a domain measure a single concept and are independent (Haley, Ni, Hambleton, Slavin, & Jette, 2006). The AM-PAC uses a computer-based format that relies on computerized adaptive testing (CAT)**,** a hierarchical system that select**s** questions appropriate for each individual, based on the participant's previous response. CAT programs work toward a goal of a set level of precision in the responses and may subsequently shorten or lengthen the set of questions until the goal is achieved, potentially reducing respondent burden (Jette & Haley, 2005). The AM-PAC has a pre-set maximum of 10 questions per domain. The AM-PAC demonstrates strong reliability (Andres, Haley, & Ni, 2003) and moderate validity (Coster, Haley, & Jette, 2006; Latham et al., 2008).

Physical performance was assessed using the Senior Fitness Test (SFT), a battery of six observation-based measures to evaluate upper body and lower body strength and flexibility,

balance, and cardio-respiratory fitness (Rikli & Jones, 1999; 2001). Measures include a chair stand test, an arm-curl test, a chair sit-and-reach test, a back-scratch test, an 8 ft. up-and-go test, and a 2-minute step test. The SFT has good validity and reliability, and has normative standards for reference by age and gender (Rikli & Jones, 2001).

Depression was evaluated using the 15-item version of the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986). This self-report tool is a shortened version of the original 30-item GDS, and is a scale to screen for depression in older adults. The short form GDS demonstrates good sensitivity and specificity for use with cognitively intact adults, when compared to the longer version of the GDS and other measures of depression (Brown, Woods, & Storandt, 2007; Burke, Roccaforte, & Wengel, 1991).

3.2.6 Procedures

Participants were recruited through a free health and wellness education session offered onsite at their residence and through study advertisements posted in multiple locations within the building. At pretest, the demographic and medical questionnaires were administered first, followed by the four outcome measures, which were administered in random order. All measures were administered by trained assessors who were independent of the intervention. Following the pretest assessments, participants engaged in a 10 week intervention. Attendance was recorded for each group session, and adherence to the home program was recorded weekly through self-report. Posttesting was completed for the SFT, AM-PAC, and GDS immediately following completion of the intervention. The YPAS was administered at 4 and 8 weeks post-intervention (See Figure 3.1). This delay was to avoid bias regarding skewed levels of activity associated with the intervention. The YPAS instructions require respondents to consider activity levels for a

typical week during the preceding month. Measures taken immediately following completion of the intervention would have been contaminated by participation in the intervention.

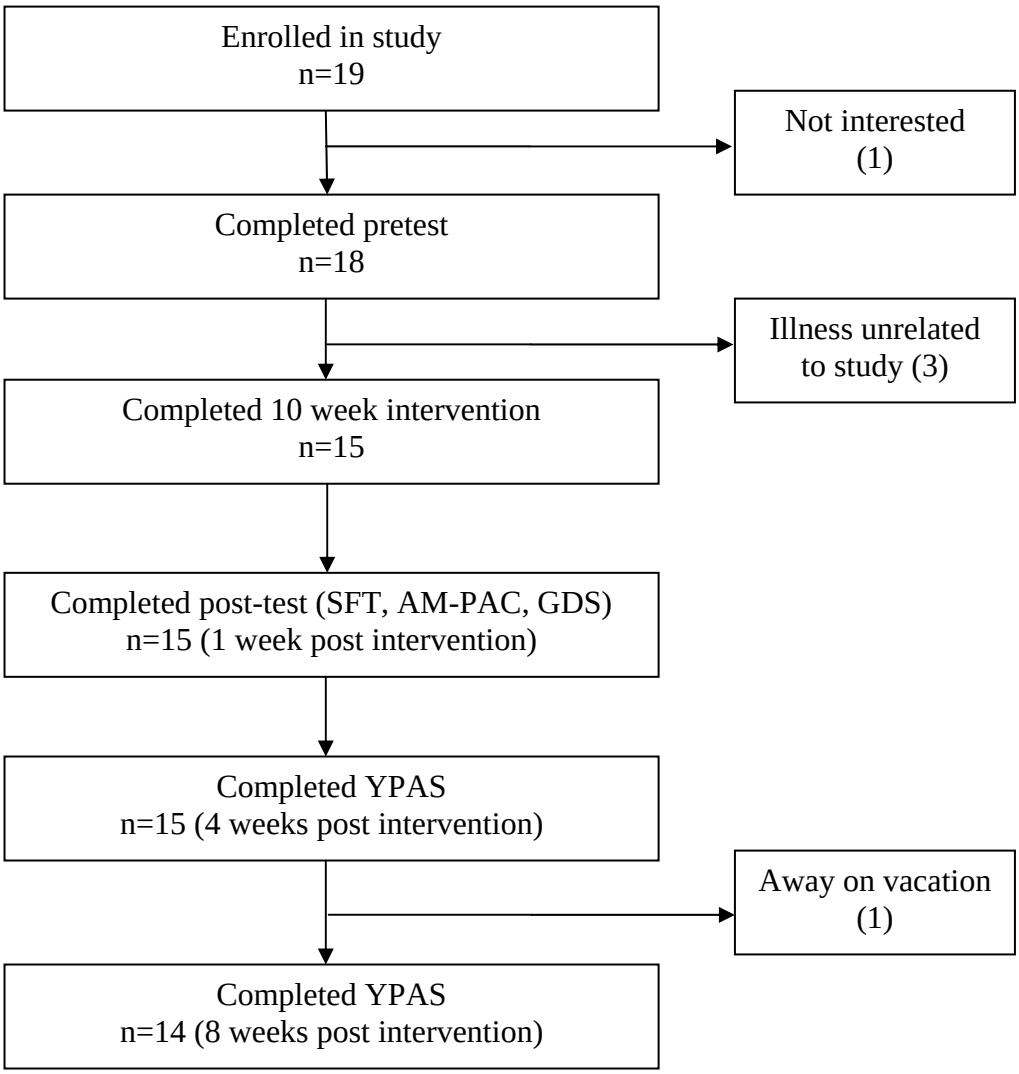

Figure 3:1 Flow of participation

3.2.7 Data Analysis

The criterion for significance (alpha) was set at 0.05. Because of the pretest, posttest, post-posttest cohort study design, the use of measures that yield quantitative data, and the expectation that participants would improve as a result of the intervention, a one-tailed paired samples t-test was completed for the SFT, AM-PAC, and GDS pretest/posttest measures. To estimate whether changes were clinically meaningful, effect sizes for paired samples t-tests were reported using Cohen's *d* values, ranging from small (*d* =.20) to medium (d = around .50) to large (d = .80; Cohen, 1988). In order to compare YPAS scores at pretest, posttest, and post-posttest, a repeated measures ANOVA was conducted. Effect sizes for the repeated measures ANOVA were reported as partial eta-squared. As effect size scores for partial eta-squared and eta-squared are identical in a repeated measures ANOVA that includes only a single factor, interpretation for strength of these values were: small (η_p^2 = .01), medium (η_p^2 = .06), and large (η_p^2 = .14; Cohen, 1988). Descriptive statistics, inferential statistics and effect sizes were computed using SPSS for Windows Version 17.

3.3 RESULTS

Of 30 potential participants screened, 19 (63.3%) met inclusion criteria. Medical clearance, as per results of the EASY screen, was required and received for two of the volunteers. Four participants withdrew because of health issues unrelated to the intervention (n=3) or disinterest (n=1). Fifteen participants completed the intervention and posttest but only 14 completed the YPAS post-posttest because one participant was on vacation. Although the study was open to

both genders, the intervention group was 100% female. They had a mean educational level of 11.5 years and were generally in good health, with degenerative joint disease being the most commonly cited medical condition (see Table 3.1). Although participants acknowledged occasional fatigue and muscle soreness, none reported any injury, exacerbation of a chronic condition, or other adverse event due to study participation.

Table 3.1 Demographic Variables and Health Characteristics of Participants

Characteristic	(*N*= 15)
Age in years *M* (*SD*)	78.1 (8.0)
Gender	
Female (%)	15 (100.0)
Race/Ethnicity	
White (%)	15 (100.0)
Marital Status	
Married (%)	2 (13.3)
Widowed (%)	11 (73.3)
Divorced (%)	2 (13.3)
Education in years *M* (*SD*)	11.5 (1.2)
Medical History	
Cardiovascular Disease (%)	3 (20.0)
Degenerative Joint Disease (%)	10 (66.7)
Hypertension (%)	9 (60.0)
Low Back Pain (%)	5 (33.3)
Chronic Obstructive Pulmonary Disease (%)	2 (13.3)
Diabetes Mellitus (%)	5 (33.3)
Average number of medications *M* (*SD*)	3.0 (1.6)

Note. *M* = mean; *SD* = standard deviation.

Program adherence for group sessions was 89.7% for those who completed the entire intervention. Adherence for completion of the home program was 78.5%. Results of a one-tailed paired samples t-test comparing pretest and posttest scores (N = 15) for the SFT, the AM-PAC, and the GDS are presented in Table 3.2. Significant change was found for all six measures of the SFT. Improvements in flexibility were observed through the back scratch and chair sit-and-reach, and aerobic endurance gains were noted through the 2-minute step test. The chair stand and arm curl tests reflected improvement in strength, and the 8 ft. up-and-go demonstrated increased agility and balance. When compared to normative data specific to age and gender, pretest scores on the SFT were very low, ranging from the 20th percentile for the arm-curl test to below the 5th percentile for the 2 minute step test and for the 8 ft. up-and-go. Posttest scores demonstrated an average gain of 20% when compared to age and gender norms. The AM-PAC scores indicated significant improvement for Daily Activities and Applied Cognition. Although change in the Basic Mobility domain of the AM-PAC did not reach statistical significance, scores did indicate improvement. No change was observed in the GDS scores for depression. Large effect sizes (Cohen's d) were found for five outcome scores on the SFT, and two AM-PAC measures. The back scratch (upper body flexibility) test of the SFT and the AM-PAC Basic Mobility domain produced medium effect sizes.

Table 3.2 Outcome Data for SFT, AM-PAC, and GDS Measures (N = 15)

	Pretest		Posttest				
Outcomes (n=15)	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Senior Fitness Test							
Chair sit and reach, inch	-3.27	4.93	0.00	3.03	2.88	.006	1.05
Back scratch, inch	-8.53	7.69	-5.77	6.23	1.92	.040	0.70
Arm curl, repetition	10.80	1.97	14.53	4.00	3.66	.002	1.34
Chair stand, repetition	8.20	3.90	10.47	4.70	2.94	.006	1.07
2 minute step, repetition	44.80	20.93	75.20	25.50	5.37	<.001	1.96
8 ft. up-and-go, second[a]	11.12	4.33	8.71	4.46	-9.79	<.001	3.57
Activity Measure-Post Acute Care							
Daily Activity	53.82	7.01	58.28	9.87	2.13	.025	0.78
Basic Mobility	60.92	6.36	63.31	5.58	1.60	.067	0.58
Applied Cognition	45.97	6.55	49.91	7.03	2.33	.018	0.85
Geriatric Depression Scale[a]	2.07	1.83	2.27	2.58	0.30	.380	0.11

Note. [a] Lower scores indicate improvement. EE = energy expenditure; kcal = kilocalorie.

Scores for those participants completing all 3 administrations of the YPAS (n = 14) were examined through a repeated measures analysis of variance (ANOVA; see Table 3.3). Of the eight YPAS indices, significance for the main effect was found for Total Time, Total Energy Expenditure, and the Leisurely Walking Index. Post-hoc analyses for these three indices using the Bonferroni adjustment revealed no significant differences, except for the Leisurely Walking Index from pretest to posttest. Partial eta-squared effect sizes ("the proportion of variance that a variable explains that is not explained by other variables") (Field, 2009, p. 791) for the repeated measure ANOVA were very large for the three indices demonstrating a main effect. Effect sizes were medium to large for the Standing Index, Sitting Index, and Activity Dimension Index and small for the Vigorous Activity Index and Moving Index. Because of the potential loss of critical data due to the decrease in sample size from posttest (N = 15) to post-posttest (n = 14), a one-tailed paired samples t-test (N = 15) was completed for pretest to posttest scores on the YPAS (data not shown). A comparison of these paired samples t-test scores (N = 15) to the scores of the repeated measures ANOVA (n = 14) affirm that loss to follow-up did not appear to skew the YPAS results.

Table 3.3 Repeated Measures ANOVA for the Yale Physical Activity Scale (YPAS)

	Pretest		Posttest		Post-Posttest			
YPAS (n = 14)	*M*	*SD*	*M*	*SD*	*M*	*SD*	*p*	η_p^2
Total Time	24.55	17.25	31.07	21.71	31.07	27.76	.032	.241
Total EE (kcals)	4667.79	3323.59	5711.25	3521.04	8104.82	5349.08	.032	.233
Vigorous Activity Index	9.29	12.99	12.50	10.70	12.14	16.14	.621	.036
Leisurely Walking Index	6.29	7.48	14.00	7.65	12.00	7.52	.039	.220
Moving Index	8.79	5.58	9.21	2.75	8.79	3.62	.884†	.005
Standing Index	4.00	2.35	4.86	1.51	5.43	3.96	.322	.084
Sitting Index[a]	2.71	1.82	1.93	0.73	2.14	0.77	.180†	.131
Activity Summary Index	31.07	18.39	42.50	16.46	40.50	24.92	.150	.136

Note. † Calculations using Huynh-Feldt secondary to Sphericity violated. [a] Lower scores indicate improvement. η_p^2 = partial eta-squared; EE = Energy Expenditure; kcal = kilocalorie.

3.4 DISCUSSION

Few studies targeting physical activity for older adults incorporate best practice guidelines or focus on the range of outcomes that affect life participation (ACSM et al., 2009). The purpose of this pretest, posttest, and post-posttest cohort study was to determine if a low-cost, community-based exercise and physical activity program with all the recommended components of best practice would increase physical activity levels and improve ADL performance for seniors from low-income households. Our intervention yielded high participation rates and increased levels of ADL-related physical activity, significant reductions in ADL limitations, and improvement in physical performance areas including endurance, strength, flexibility and balance. These findings support the use of the FSAH as an effective exercise and physical activity program for this population.

In a meta-analysis examining the impact of multi-component exercise programs for older adults, Baker, Atlantis, et al. (2007) concluded that such programs had little to no effect on function. However, none of the studies reviewed in the meta-analysis evaluated ADL performance, and function was defined only as falls incidence, gait velocity, bone mineral density and the ability to move from sit to stand. Few exercise studies have included ADL performance as a functional outcome (ACSM et al., 2009; Keysor & Jette, 2001), and of those multi-component exercise studies incorporating direct or indirect ADL measures to assess change, the results have often been nonsignificant (Binder et al., 2002; Kolbe-Alexander, Lambert, & Charlton, 2006; Lord et al., 2003). The current study, with a primary interest in function as reflected through ADL performance, reported a significant reduction in perceived

difficulty and in need for assistance with daily activities following participation in the FSAH intervention. Cognition for daily living also improved significantly. In addition to a change in the quality of ADL performance, the amount of ADL participation increased. Scores from the YPAS indicated significant gains in physical activity for both time and energy spent performing daily activities such as household tasks, exercise, and recreational activity. Medium to large effect sizes for nearly all the AM-PAC domains and YPAS indices suggest these changes are clinically meaningful. The intent of our post-posttest measure was to evaluate sustainability of gains in physical activity realized through participation in the intervention. Over the three measurement time points, the YPAS Index scores reflected a positive change in behavior patterns, trending from sedentary to more active levels of participation. Some studies using the YPAS have included only select indices for measurement and have administered it immediately post-intervention (Resnick, 2002; Resnick, Luisi, et al., 2008; Resnick, Orwig, et al., 2007; Resnick et al., 2009). Our administration timetable for the YPAS eliminated the potential for the intervention itself to be a confounding variable, and we included analysis of all eight indices. Such efforts strengthened our findings and provide a more comprehensive understanding of changes realized through physical activity as a result of the FSAH intervention. Martin Ginis, Latimer, Brawley, and Jung (2006) demonstrated the positive effect of educating older adults on the relationship between exercise and ADLs on self-efficacy. The protocol for our intervention promoted the link between exercise and ADLs through the FSAH self-assessment survey and through post-exercise discussion of improvements in ADLs over the 10 week intervention. Heightened awareness of ADL performance as a result of such efforts, in addition to the exercise intervention itself, may have influenced subject response post-intervention on the AM-PAC and YPAS.

Physical performance is the most frequently described and measured outcome for exercise and physical activity interventions (Baker, Atlantis, et al., 2007; Chin a Paw et al., 2008; Keysor & Jette, 2001). Evidence of the effect of exercise on physiological functions such as endurance and strength for older adults is strong (ACSM et al., 2009; Peterson et al., 2009). Our study found similar results, with participants significantly improving on all six SFT physical performance measures. We purposefully recruited inactive seniors and this was reflected by their pretest SFT scores, which were at the lowest end of the norms for their age and gender (Rikli & Jones, 2001). In comparing posttest scores to the normative performance standards, upper body strength and endurance showed the greatest improvement, whereas dynamic balance and agility, as measured by the 8 ft. up-and-go, yielded the smallest change. The FSAH program does not include agility exercises, which may have influenced these results. Our participants experienced physical performance gains through a low to moderately intense protocol using exercise bands. A randomized controlled trial (RCT) by Toraman et al. (2004) yielded significant results with large effect sizes for all 6 SFT scores, but used weights and a protocol that transitioned from a moderate to high intensity. Pre-post cohort studies by Moore-Harrison et al., (2009) in congregate-meal sites, and Page et al. (2006) using the FSAH intervention, used a moderately-intense protocol and noted improvement in 5 of 6 SFT measures. Evidence exists that high intensity exercise protocols and the use of high cost exercise equipment are effective tools for improving physical performance in older adults (Fiatarone et al., 1994; Seynnes et al., 2004). However, our study indicates that gains in physical performance can also be achieved with low-cost equipment and an exercise program of a lower intensity, which may be more acceptable and sustainable in this population.

Considerations such as cost and exercise intensity are critical for successful development of community-based exercise and physical activity programs for older adults. Older adults of low socioeconomic status are less likely to participate in physical activity due to real barriers such as transportation, time, and expense, and perceived barriers, such as fear of injury and reduced self-efficacy (Boyette et al., 2002; Brawley et al., 2003, Schutzer & Graves, 2004). Our study minimized these barriers by hosting all study activities onsite within the senior high rise, providing exercise materials at no cost, limiting session frequency to twice per week, and offering a non-threatening exercise program. In addition to the elimination of barriers, Jancey et al. (2008) noted the importance of enabling and reinforcing factors as motivators for participation in community-based programs. Our study included many of the characteristics ascribed to successful physical activity programs including a group format, self-efficacy activities, and a positive social atmosphere (Prohaska et al., 2006; Smedley & Syme, 2001). We regularly reminded participants of potential ADL benefits realized through continued participation and included incentives such as refreshments and giveaways, to increase motivation. As a result, our retention and adherence rates were equivalent to or better than other community-based, multi-component, older adult exercise interventions (Baker, Kennedy, et al., 2007; Belza et al., 2006; Binder et al., 2002; Fahlman et al., 2007; Hughes et al., 2009; LIFE Study Investigators et al., 2006; Lord et al., 2003; Martin & Sinden, 2001; Moore-Harrison et al., 2009; Opdenacker et al., 2008; Resnick, Luisi, et al., 2008; Toraman et al., 2004; Wallace et al., 1998; Worm et al., 2001; Yan et al., 2009; Van Roie et al., 2010). The high level of participation in our study reinforces the need to consider barriers and motivators in the development of exercise and physical activity programs for low-income older adults.

Despite our success with retaining and engaging participants throughout the intervention, recruitment was difficult. Only 15% of those living in the senior apartment building attended the initial free health and wellness seminar offered onsite, and only 9% of all residents participated in the study. Studies by Baker, Kennedy, et al. (2007) and Lord et al. (2003) that drew subjects from retirement villages in Australia, another "contained" population, reported lengthier and more intense recruitment efforts, with much higher recruitment percentages. International perceptions regarding exercise as well as social and demographic contrasts between senior high rises and retirement villages may have influenced their recruitment success. For our study, interest from non-participating residents increased once they became more familiar with the interventionist, observed that the intervention was safe, and confirmed that there was no cost to participate. This suggests that additional educational efforts and use of familiar staff may have improved our recruitment results.

Participants in the current study realized gains in ADLs and physical performance through a 10 week intervention. The intervention period for other older adult, multi-component exercise programs has ranged from 9 weeks to 12 months, producing variable results and demonstrating few patterns linking length of study to effectiveness of the intervention (Hughes et al., 2009; LIFE Study Investigators et al., 2006; Opdenacker et al., 2008; Toraman et al., 2004; Van Roie et al., 2010). Even when exercise and physical activity programs demonstrate post-intervention effectiveness, maintaining functional improvements over time remains a challenge (Rhodes et al., 1999; Schutzer & Graves, 2004). Sustainability of functional gains and continued adherence to exercise and physical activity programs is a critical consideration that is often not adequately addressed (McCauley, Jerome, Elavsky, Marquez, & Ramsey, 2003; Rhodes et al., 1999). In a 12 month follow-up for a multi-component exercise intervention that produced

significant outcomes, Opdenacker et al. (2008) reported that all gains initially achieved by the exercise group were lost. Interventions that include a plan for maintenance in the protocol, in contrast, have noted better long-term results (LIFE Study Investigators et al., 2006). Sustainability was addressed in the current study through provision of a home exercise program and through post-exercise discussions on ways to increase physical activity within a daily routine. Additionally, an attempt to formally continue weekly group sessions post-intervention through training and use of facility staff was initiated, but later determined unfeasible due to facility policy and resource limitations. Despite a somewhat short follow-up period, our findings noted sustained or improved levels of physical activity on the YPAS at 8 weeks post-intervention for 7 of 8 indices.

Depression was included as an outcome in this study because older adults of low socioeconomic status are at higher risk for depression (O'Connor, Whitlock, Gaynes, & Beil, 2009), and because research supports the positive effect of exercise for management of depressive symptoms (Singh et al., 2001). Multi-component exercise studies in senior centers by Resnick, Luisi, et al. (2008), and Wallace et al. (1998) noted significant reductions in depression in their outcomes. Our sample group was relatively healthy and displayed very low pretest scores for risk for depression on the GDS. Given the fact that our participants were not depressed, it is not surprising that our results demonstrated no statistical or clinical change in depressive symptoms.

The primary limitation of this study was its sample size. The priori power analysis completed using the YPAS indicated the need for a sample size of 27 participants to avoid risk of a Type II error, but we were only able to recruit 19 participants. The medium to large effect sizes, noted for those outcome scores on the AM-PAC and YPAS that did not reach statistical

significance, suggest that a larger sample would have led to stronger results. While the intention of this study was to recruit a diverse sample group with representation of both genders, all participants in this study were white females. The homogeneity of our sample limits the ability to generalize the findings to mixed populations of racially diverse, community-dwelling older adults from low-income income households.

Although inclusion of a control group would have strengthened our findings, our study successfully demonstrated the feasibility of implementing the FSAH, a low-cost, multi-component exercise and physical activity program, with a group of community-dwelling older adults of low-income. This study addressed a unique population at high risk for sedentary behavior by minimizing barriers, providing incentives as motivation, and introducing behavioral change strategies. Unlike most other multi-component exercise and physical activity interventions, we included all recommended components of best practice, and targeted change in ADL performance as a measure of functional improvement. The statistical as well as clinical significance of our findings provide a foundation for understanding how to promote participation and ADL independence through low-cost physical activity programs for seniors living in the community.

3.5 CONCLUSION

This pretest, posttest, post-posttest cohort study supports use of a best practice exercise and physical activity program (FSAH) with community-dwelling older women from low-income households to increase physical activity levels for ADLs, reduce ADL-related activity limitation, and improve physical performance. Inclusion of this combination of outcome measures attempts

to address the broad number of factors believed to impact participation, health, and sustained independence. The low-cost design of the FSAH, combined with an intentional elimination of many common barriers to physical activity engagement, makes the FSAH a viable option for use in community programs and community housing. Additional research on best practice physical activity programs in the form of randomized clinical trials, that include ADL performance as an outcome and recruit a more diverse population, are needed to better understand the causal relationship between physical activity, activities of daily living, and well-being for older adults.

4.0 SUMMARY AND CONCLUSION

This dissertation addressed two aims. The first aim was to evaluate and synthesize the current literature on group-based, multi-component exercise and physical activity programs for community-dwelling, older adults. Our second aim was to examine the effect of participation of sedentary, community-dwelling older adults from low-income households in the First Step to Active Health (FSAH), a best practice exercise and physical activity program, on physical activity, performance of activities of daily living (ADL), physical performance, and depression. Physical inactivity in older adults is an international public health concern (Administration on Aging, 2009). There is strong evidence for the benefits of physical activity on health for older adults, however, the direct impact of exercise and physical activity on ADL function, a primary determinant for independent living, is not well understood (ACSM et al., 2009; Keysor & Jette, 2001). Our research, with its focus on ADL performance, contributes unique information to this body of knowledge.

In 2004, the American College of Sports Medicine (ACSM) published best practice guidelines for older adults, recommending group-based, multi-component exercise and physical activity programs that incorporate behavioral change strategies. We conducted a systematic review to analyze the available evidence for best practice programs, including their impact on ADL performance. Studies were considered if they were group-based, included at least 3 exercise components in the intervention, and targeted a mixed gender of older adults living in the

community. Given the amount of recent research on physical activity, we limited the review to studies published from 1998 to August 2010. Our comprehensive literature search yielded 15 studies, including 12 randomized controlled trials and 3 studies employing a quasi-experimental design. Of these, only four studies included behavioral change as a component of the exercise intervention, and hence included all the features recognized as best practice. Broad variability was noted in the 15 studies' objectives, methods of exercise program delivery, duration of interventions, and outcomes. ADL performance, examined in just two studies, was the least frequently included outcome. Conversely, physical performance was assessed in nearly every study. Statistically significant improvement was most often observed for physical performance; results for physical activity, ADL performance, quality of life, depression, and self-efficacy outcomes were more varied. No patterns emerged, linking results to a specific study design or intervention. With a combined average retention rate of 79%, the exercise interventions examined in this review realized high rates of retention. Adherence rates were more variable and appeared to be at least partially dependent on single site versus multi-site interventions, ranging from 43% to 100%. Sustainability of long-term gains following completion of the exercise and physical activity intervention was a consideration in only two studies. Results of this systematic review failed to strengthen our understanding of the impact of best practice programs on ADL function, thereby supporting the need for our intervention study.

Our pretest, posttest, and post-posttest study was conducted to evaluate the effectiveness of an exercise and physical activity intervention for older adults that included all the recommended components of best practice, and targeted ADL performance as a functional outcome. The intervention followed the exercise and physical activity guidelines of the First Step to Active Health (FSAH) program. The FSAH, a best practice, multi-component exercise

program, was created as part of an Active Aging Toolkit (Human Kinetics, 2004; Page et al., 2004). Despite its development and endorsement by a team of professional organizations, there is minimal published research supporting its use (Page et al., 2004; Page et al., 2006). The FSAH was selected for this study because of its low-cost design, incorporation of self-efficacy enhancing activities, and inclusion of self-assessment and goal-setting features linking the exercise program to ADL participation. Our sample was comprised of residents from a senior public housing apartment building. We focused our research on older adults from low-income households because their socioeconomic status presents more barriers and puts them at greater risk for sedentary behavior than the general older adult population (Boyette et al., 2002; Brawley et al., 2003, Schutzer & Graves, 2004). We designed our study to systematically reduce or eliminate known barriers to participation. While we recruited a population of mixed gender, our final sample (N = 15) was 100% Caucasian females, with an average age of 78 years, and mostly widowed. These characteristics were consistent with the demographics of the population residing in the apartment building. Based on an estimated need determined through a power analysis, our sample size was smaller than desired. Informal feedback from residents of the senior apartment building who did not participate in the study suggests that a lengthier recruitment period and additional recruitment strategies may have generated a larger sample group.

Despite our study being underpowered, posttest results following the 10 week intervention demonstrated statistically significant results in 2 of 3 ADL domains on the Activity Measure-Post Acute Care (AM-PAC) and on all 6 physical performance measures of the Senior Fitness Test (SFT), with medium to large effect sizes. Scores on the Geriatric Depression Scale (GDS) reflected no change; however, this was not surprising given that our participants were not depressed and demonstrated low GDS scores on the pretest.

Physical activity gains realized through participation in the intervention were analyzed using the YPAS at 4 weeks and at 8 weeks post intervention (posttest and post-posttest) to evaluate change and sustainability of those changes in physical activity levels. Repeated measures analysis of variance (ANOVA) revealed statistical significance on the main effect for Total Activity Hours, Total Energy Expenditure and the Leisurely Walking Index. The post-hoc analyses using the Bonferroni adjustment revealed significant differences only for the Leisurely Walking Index from pretest to posttest. Partial eta-squared effect sizes were medium to large for all indices except the Moving Index. Over the pretest, posttest, and post-posttest measurement time points, the YPAS Index scores reflected a trend from sedentary to more active levels of participation in ADLs, suggesting a positive change in behavior patterns.

With a retention rate of 78.9%, and an adherence rate for group sessions of 89.7%, our results were very similar to the high average rates of retention and adherence noted in our systematic review. In contrast to our findings, retention and adherence continue to be critical issues in exercise and physical activity programs for older adults at the public health level (Chao et al., 2000). Potential causes for such differences must be further examined to successfully translate these intervention studies to larger, public health programs.

We employed a quasi-experimental research design to investigate the effectiveness of a relatively untested physical activity intervention on ADL performance, a critical, yet infrequently assessed outcome. Our study population of older adults from low-income households represented one of the most challenging groups to engage in physical activity. Combined, these features represented a novel study. While our significant results provide a foundation for understanding the relationship between engagement in physical activity and its impact on ADL function, a repeated and more rigorous study in the form of a randomized controlled trial would provide

more robust evidence of these effects. In addition to a stronger research design, future studies should consider inclusion of outcome measures that will best reflect ADL function. We evaluated ADL performance through 2 self-report tools – the AM-PAC and the YPAS. The AM-PAC assessed perceived difficulty and limitations in daily activity, whereas the YPAS quantified changes in the level of physical activity in the context of ADLs. While both measures provided valuable data, combining use of these tools with an observation-based measure of ADL function may provide stronger validation of the results. Additionally, future studies may consider inclusion of a qualitative measure to capture change in ADL performance, as it is uniquely perceived by each participant. Depression was included as an outcome in the current study because of the high risk for depression in older adults of low socioeconomic status and the well-documented effects of exercise for reducing depressive symptoms (O'Connor et al., 2009; Singh et al., 2001). Because our sample was not depressed, the assessment contributed minimal value to our results. In future studies, inclusion of an alternate, positive measure of affect may be more sensitive to the changes experienced by older adults participating in an exercise and physical activity intervention.

In conclusion, our results support use of a best practice exercise and physical activity program (FSAH) to improve physical activity, ADL performance, and physical performance in older adults from low-income households. This evidence affirms the potential for improving health, participation, ADL independence, and quality of life for older adults through increased physical activity, and offers a strategy for implementation of these goals consistent with best practice guidelines.

BIBLIOGRAPHY

Abbott, R. D., White, L. R., Ross, G. W., Masaki, K. H., Curb, J. D., & Petrovitch, H. (2004). Walking and dementia in physically capable elderly men. *Journal of the American Medical Association, 292*, 1447-1453. doi:10.1001/jama.292.12.1447

Ackerman, R. T., Williams, B., Nguyen, H. Q., Berke, E. M., Maciejewski, M. L., & LoGerfo, J. P. (2008). Healthcare cost differences with participation in a community-based group physical activity benefit for Medicare managed care health plan members. *Journal of the American Geriatric Society, 56*, 1459-1465. doi: 10.1111/j.1532-5415.2008.01804.x

Administration on Aging (2009). *Aging statistics*. Retrieved from http://www.aoa.gov/aoaroot/aging_statistics/Profile/2009/4.aspx

Agency for Healthcare Research and Quality. (2002). *Physical activity and older Americans*. U.S. Department of Health and Human Services. Retrieved from http://www.ahrq.gov/ppip/activity.htm

American College of Sports Medicine. (1998). ACSM position stand: Exercise and physical activity for older adults. *Medicine and Science in Sports & Exercise, 30*, 992-1008.

American College of Sports Medicine. (2004). Physical activity programs and behavior counseling in older adult populations. Best practices statement. *Medicine and Science in Sports & Exercise, 36,* 1997-2003. doi: 10.1249/01.MSS.0000145451.08166.97

American College of Sports Medicine, Chodzko-Zajko, W. J., Proctor, D. N., Fiatarone Singh, M. A., Minson, C. T., Nigg, C. R.,…Skinner, J. S. (2009). American College of Sports Medicine position stand: Exercise and physical activity for older adults. *Medicine and Sciences in Sports & Exercise, 41,* 1510-1530. doi: 10.1249/MSS.0b013e3181a0c95c

Andres, P., Haley, S. M., & Ni, P. S. (2003). Are patient-reported functional measures reliable in monitoring post acute outcomes? *American Journal of Physical Medicine and Rehabilitation, 82*, 614-621. doi: 10.1097/01.PHM.0000073818.34847.F0

Baker, M. K., Atlantis, E., & Fiatarone Singh, M. A. (2007). Multi-modal exercise programs for older adults. *Age and Aging, 36*, 375-381. doi:10.1093/ageing/afm054

Baker, M. K., Kennedy, D. J., Bohle, P. L., Campbell, D. S., Knapman, L., Grady, J.,…Fiatarone Singh, M. A. (2007). Efficacy and feasibility of a novel tri-modal robust exercise prescription in a retirement community: A randomized, controlled trial. *Journal of the American Geriatrics Society, 55*, 1-10. doi: 10.1111/j.1532-5415.2006.01031.x

Bandura, A., & Cervone, D. (1983). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *Journal of Personality and Social Psychology, 45,* 1017-1038. doi:10.1037//0022-3514.45.5.1017

Belza, B., Shumway-Cook, A., Phelan, E. A., Williams, B., Snyder, S. J., & LoGerfo, J. P. (2006). The effects of a community-based exercise program on function and health in older adults: The EnhanceFitness program. *Journal of Applied Gerontology, 25*, 291-306. doi: 10.1177/0733464806290934

Binder, E. F., Schechtman, K. B., Ehsani, A. A., Steger-May, K., Brown, M., Sinacore, D. R.,…Holloszy, J. O. (2002). Effects of exercise training on frailty in community-dwelling older adults: Results of a randomized, controlled trial. *Journal of the American Geriatrics Society, 50,* 1921-1928. doi:10.1046/j.1532-5415.2002.50601.x

Borg, G.A.V. (1998). *Borg's Perceived Exertion and Pain Scales*. Champaign, IL: Human Kinetics.

Boston University. (2007). *Activity measure for post acute care. Instruction manual*. Retrieved from www.crecare.com/AM_PAC_CAT_manual_5.1.07.pdf

Boyette, L. W., Lloyd, A., Boyette, J. E., Watkins, E., Furbush, L., Dunbar, S. B., & Brandon, L. J. (2002). Personal characteristics that influence exercise behaviors of older adults. *Journal of Rehabilitation Research and Development, 39*, 95-103.

Brawley, L. R., Rejeski, W. J., & King, A. C. (2003). Promoting physical activity for older adults: The challenges for changing behavior. *American Journal of Preventive Medicine, 25*, 172-183.

Brown, P. J., Woods, C. M., & Storandt, M. (2007). Model stability of the 15-item geriatric depression scale across cognitive impairment and severe depression. *Psychology and Aging, 22,* 372-379.

Buchner, D. M., Beresford, S. A., Larson, E. B., LaCroix, A. Z., & Wagner, E. H. (1992). Effects of physical activity on health status in older adults II: Intervention studies. *Annual Review of Public Health, 13*, 469-488. doi:10.1146/annurev.publhealth.13.1.469

Burbank, P. M., & Riebe, D. (Eds.). (2002). *Promoting exercise and behavior change in older adults*. New York: Springer Publishing.

Burke, W. J., Roccaforte, W. H., & Wengel, S. P. (1991). The short form of the Geriatric Depression Scale: A comparison with the 30-item form. *Journal of Geriatric Psychiatry and Neurology, 4,* 173-178.

Callahan, C. M., Unverzagt, F. W., Hui, S. L., Perkins, A. J., & Hendrie, H. C. (2002). Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Medical Care, 40*, 771-781.

Centers for Disease Control. (n.d.). *Physical activity for everyone. Perceived exertion (Borg's rating of perceived exertion scale).* Retrieved from http://www.cdc.gov/physicalactivity/everyone/measuring/exertion.html

Chao, D., Foy, C. G., & Farmer, D. (2000). Exercise adherence among older adults: Challenges and strategies. *Controlled Clinical Trials, 21*, 212S–217S.

Chin A Paw, M. J. M., van Uffelen, J. G. Z., Riphagen, I., & van Mechelen, W. (2008). The functional effects of physical exercise training in frail older people: A systematic review. *Sports Medicine, 38*, 781-793.

Clemson, L., Cumming, R. G., Kendig, H., Swann, M., Heard, R., & Taylor, K. (2004). The effectiveness of a community-based program for reducing the incidence of falls in the elderly: A randomized trial. *Journal of the American Geriatric Society, 52*, 1487-1494. doi:10.1111/j.1532-5415.2004.52411.x

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Coster, W. J., Haley, S. M., Andres, P. L., Ludlow, L. H., Bond, T. L. Y., & Ni, P. (2004). Refining the conceptual basis for rehabilitation outcome measurement. Personal care and instrumental activities domain. *Medical Care, 42,* I62-I72. doi: 10.1097/01.mlr.0000103521.84103.21

Coster, W. J., Haley, S. M., & Jette, A. M. (2006). Measuring patient-reported outcomes after discharge from inpatient rehabilitation settings. *Journal of Rehabilitation Medicine, 38*, 237-242.

Courtney, M., Edwards, H., Chang, A., Parker, A., Finlayson, K., & Hamilton, K. (2009). Fewer emergency readmissions and better quality of life for older adults at risk of hospital readmission: A randomized controlled trial to determine the effectiveness of a 24-week exercise and telephone follow-up program. *Journal of the American Geriatric Society, 57,* 395-402. doi: 10.1111/j.1532-5415.2009.02138.x

Cress, M. E., Buchner, D. M., Prohaska, T., Rimmer, J., Brown, M., Macera, C.,…Chodzko-Zajko, W. (2005). Best practices for physical activity programs and behavior counseling in older adult populations. *Journal of Aging & Physical Activity, 13*, 61-74.

DiPietro, L., Caspersen, J., Ostfeld, A. M., & Nadel, E. R. (1993). A survey for assessing physical activity among older adults. *Medicine and Science in Sports and Exercise, 25*, 628-642. doi:10.1249/00005768-199305000-00016

Fahlman, M. M., Topp, R., McNevin, N., Morgan, A. L., & Boardley, D. J. (2007). Structured exercise in older adults with limited functional ability. *Journal of Gerontological Nursing, 33,* 32-39.

Fiatarone, M. A., O'Neill, E. F., Ryan, N. D., Clements, K. M., Solares, G. R., Nelson, M. E.,…Evans, W. J. (1994). Exercise training and nutritional supplementation for physical frailty in very elderly people. *New England Journal of Medicine, 330*, 1769-1775. doi:10.1056/NEJM199406233302501

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). Los Angeles, CA: SAGE.

Fillenbaum, G. G., & Smyer, M. A. (1981). The development, validity, and reliability of the OARS multidimensional functional assessment questionnaire. *Journal of Gerontology, 36,* 428-434.

Fisher, A. G. (1992). Functional measures, part 1: What is function, what should we measure, and how should we measure it? *American Journal of Occupational Therapy, 46*, 183-185.

Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., Gottdiener, J.,…McBurnie, M. A. (2001). Frailty in older adults: Evidence for a phenotype. *Journals of Gerontology: Medical Sciences, 56*, M146-M156. doi:10.1093/gerona/56.3.M146

Guralnik, J. M., Fried, L. P., & Salive, M. E. (1996). Disability as a public health outcome in the aging population. *Annual Review of Public Health*, *17*, 25-46.

Haley, S. M., Andres, P. L., Coster, W. J., Kosinski, M., Ni, P. S., & Jette, A. (2004). Short-form activity measure for post-acute care (AM-PAC). *Archives of Physical Medicine and Rehabilitation, 85,* 649-660. doi:10.1016/j.apmr.2003.08.098

Haley, S. M., Coster, W. J., Andres, P. L., Luklow, L. H., Ni, P., Bond, T. L. Y.,…Jette, A. M. (2004). Activity outcome measurement for postacute care. *Medical Care, 42*, I49-I61. doi:10.1097/01.mlr.0000103520.43902.6c

Haley, S. M., Ni, P., Hambleton, R. K., Slavin, M. D., & Jette, A. M. (2006). Computer adaptive testing improved accuracy and precision of scores over random item selection in a physical functioning item bank. *Journal of Clinical Epidemiology, 59,* 1174-1182. doi:10.1016/j.jclinepi.2006.02.010

Harada, N. D., Chiu, V., King, A. C., & Stewart. (2001). An evaluation of three self-report physical activity instruments for older adults. *Medicine and Science in Sports and Exercise, 33,* 962-970. doi:10.1097/00005768-200106000-00016

Hirsch, M. A., Toole, T., Maitland, C. G., & Rider, R. A. (2003). The effects of balance training and high-intensity resistance training on persons with idiopathic Parkinson's disease. *Archives of Physical Medicine and Rehabilitation, 84,* 1109-1117. doi:10.1016/S0003-9993(03)00046-7

Hughes, S. L., Seymour, R. B., Campbell, R. T., Whitelaw, N., & Bazzarre, T. (2009). Best-practice physical activity programs for older adults: Findings from the National Impact Study. *American Journal of Public Health, 99*, 362-368. doi:10.2105/AJPH.2007.131466

Human Kinetics. (2004). *National blueprint: Increasing physical activity among adults age 50 and older*. Retrieved from http://www.agingblueprint.org/ViewArticle.cfm?id=152&class=0

Jancey, J. M., Clarke, A., Howat, P. A., Lee, A. H., Shilton, T., & Fisher, J. (2008). A physical activity program to mobilize older people: A practical and sustainable approach. *The Gerontologist, 2*, 251-257.

Jette, A. M., & Cleary, (1987). Functional disability assessment. *Physical Therapy, 67*, 1854-1859.

Jette, A. M., & Haley, S. M. (2005). Contemporary measurement techniques for rehabilitation outcomes assessment. *Journal of Rehabilitation Medicine, 37,* 339–345. doi:10.1080/16501970500302793

Keysor, J. J., & Jette, A. M. (2001). Have we oversold the benefit of late-life exercise? *Journal of Gerontology: Medical Sciences*, *56*, M412-M423. doi:10.1093/gerona/56.7.M412

King, A. C., Rejeski, W. J., & Buchner, D. (1998). Physical activity interventions targeting older adults: A critical review and recommendations. *American Journal of Preventative Medicine, 15*, 313-333. doi:10.1016/S0749-3797(98)00085-3

Kinsella, K., & Velkoff, V. A. (2001). *An aging world: 2001*. (U.S. Census Bureau, Series P95/01-1). U.S. Government Printing Office, Washington, DC. Retrieved from http://www.census.gov/prod/2001pubs/p95-01-1.pdf

Kolbe-Alexander, T. L., Lambert, E. V., & Charlton, K. E. (2006). Effectiveness of a community based low intensity exercise program for older adults. *The Journal of Nutrition, Health, & Aging, 10,* 21-29.

Kruger, J., Carlson, S. A., & Buchner, D. (2007). How active are older Americans? *Preventing Chronic Disease, 4*, 1-12.

Latham, N. K., Mehta, V., Nguyen, A. M., Jette, A. M., Olarsch, S., Papanicolaou, D., Chandler, J. (2008). Performance-based or self-report measures of physical function: Which should be used in clinical trials of hip fracture patients? *Archives of Physical Medicine and Rehabilitation, 89*, 2145-2155. doi:10.1016/j.apmr.2008.04.016

Leveille, S. G., Fried, L. P., McMullen, W., & Guralnik, J. M. (2004). Advancing the taxonomy of disability in older adults. *Journal of Gerontology: Medical Sciences, 59*, 86-93. doi:10.1093/gerona/59.1.M86

LIFE Study Investigators, Pahor, M., Blair, S. N., Espeland, M., Fielding, R., Gill, T. M.,…Studenski, S. (2006). Effects of a physical activity intervention on measures of physical performance: Results of the Lifestyle Interventions and Independence for Elders Pilot (LIFE-P) study. *Journals of Gerontology: Medical Sciences, 61*, 1157-1165.

Lord, S. R., Castell, S., Corcoran, J., Dayhew, J., Matters, B., Shan, A., & Williams, P. (2003). The effect of group exercise on physical functioning and falls in frail older people living in retirement villages: A randomized controlled trial. *Journal of the American Geriatrics Society, 51*, 1685-1692. doi:10.1046/j.1532-5415.2003.51551.x

Martin Ginis, K. A., Latimer, A. E., Brawley, L. R., & Jung, M. E. (2006). Weight training to activities of daily living: Helping older adults make a connection. *Medicine & Science in Sports & Exercise, 38*, 116-121. doi: 10.1249/01.mss.0000183200.64996.ef

Martin, K. A., & Sinden, A. R. (2001). Who will stay and who will go? A review of older adults' adherence to randomized controlled trials of exercise. *Journal of Aging and Physical Activity, 9*, 91-114.

McCauley, E., Jerome, G. J., Elavsky, S., Marquez, D. X., & Ramsey, S. N. (2003). Predicting long-term maintenance of physical activity in older adults. *Preventive Medicine, 37*, 110-118. doi:10.1016/S0091-7435(03)00089-6

Miller, M. D., Crotty, M., Whitehead, C., Bannerman, E., & Daniels, L. A. (2006). Nutritional supplementation and resistance training in nutritionally at risk older adults following lower limb fracture: A randomized controlled trial. *Clinical Rehabilitation, 20*, 311-323. doi:10.1191/0269215506cr942oa

Moore, A., McQuay, H., & Gray, J. A. M. (Eds.). (1995). Evidenced-based everything. *Bandolier, 1*(12), 1.

Moore-Harrison, T. L., Johnson M. A., Quinn, M. E., & Cress, M. E. (2009). An evidence-based exercise program implemented in congregate-meal sites. *Journal of Physical Activity and Health, 6,* 247-251.

Morgan, O. (2005). Approaches to increase physical activity: Reviewing the evidence for exercise-referral schemes. *Public Health, 119*, 361-370. doi:10.1016/j.puhe.2004.06.008

Murphy, S. L., Strasburg, D. M., Lyden, A. K., Smith, D. M., Koliba, J. F., Dadabhoy, D. P., & Wallis, S.M. (2008). Effects of activity strategy training on pain and physical activity in older adults with knee or hip osteoarthritis: A pilot study. *Arthritis & Rheumatism, 59*, 1480-1487. doi:10.1002/art.24105

Nelson, M. E., Rejeski, W. J., Pate, R. R., Blair, S. N., Duncan, P. W., Judge, K. O.,…Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1094-1105. doi: 10.1161/circulationaha.107.185650

O'Connor E. A., Whitlock, E. P., Gaynes, B., & Beil, T. L. (2009). *Screening for depression in adults and older adults in primary care: An updated systematic review.* (Evidence Synthesis No. 75. AHRQ Publication No. 10-05143-EF-1). Rockville, Maryland: Agency for Healthcare Research and Quality.

Opdenacker, J., Boen, F., Coorevits, N., & Delecluse, C. (2008). Effectiveness of a lifestyle intervention and a structured exercise intervention in older adults. *Preventive Medicine, 46*, 518-524. doi:10.1016/j.ypmed.2008.02.017

Page, P., Boardley, D., & Topp, R. (2006). Effectiveness of the First Step to Active Health program in senior centers. (Abstract). *Medicine and Science in Sports and Exercise, 38*, S332. doi:10.1249/00005768-200605001-01422

Page, P., Rogers, M., Topp, R., Rimmer, J., Chodzko-Zajko, W., Himes, C.,…Matthews, M. (2004). The Active Aging Toolkit: Promoting physical activity in older adults for healthcare providers. *The Hygenic Corporation.* Retrieved from www. firststeptoactivehealth.com/downloads/files/Toolkit-whitepaperREV2-16-04.pdf

Pennix, B., Messier, S. P., Rejeski, J., Williamson, J. D., DiBari, M., Cavazzini, C.,…Pahor, M. (2001). Physical exercise and prevention of disability in activities of daily living in older persons with osteoarthritis. *Archives of Internal Medicine, 161*, 2309-2316.

Pescatello, L., DiPietro, L., Fargo, A., Ostfeld, A., & Nadel. (1994). The impact of physical activity and physical fitness on health indicators among older adults. *Journal of Aging and Physical Activity, 2,* 2-13.

Peterson, M. J., Giuliani, C., Morey, M. C., Pieper, C. F., Evenson, K. R., Mercer, V., …Simonsick, E. M. (2009). Physical activity as a preventative factor for frailty: The Health, Aging, and Body Composition Study. *Journal of Gerontology: Medical Sciences, 64A*, 61-68. doi:10.1093/gerona/gln001

Phelan, E. A., Williams, B., Pennix, B., LoGerfo, J. P., & Leveille, S. G. (2004). Activities of daily living function and disability in older adults in a randomized trial of the Health Enhancement Program. *Journal of Gerontology: Medical Sciences, 59*, 838-843. doi:10.1093/gerona/59.8.M838

Prohaska, T., Belansky, E., Belza, B., Buchner, D., Marshall, V., McTigue, K.,…Wilcox, S. (2006). Physical activity, public health, and aging: Critical issues and research priorities. *Journal of Gerontology: Social Sciences, 61B*, S267-S273.

Resnick, B. (2001). Testing a model of exercise behavior in older adults. *Research in Nursing and Health, 5*, 83-92.

Resnick, B. (2002). Testing the effect of the WALC intervention on exercise adherence in older adults. *Journal of Gerontological Nursing, 28*, 40-49.

Resnick, B., King, A., Riebe, D., & Ory, M. (2008). Measuring physical activity in older adults. Use of the Community Health Activities Model Program for Seniors physical activity questionnaire and the Yale Physical Activity Survey in three behavior change consortium studies. *Western Journal of Nursing Research, 30*, 673-689. doi:10.1177/0193945907311320

Resnick, B., Luisi, D., & Vogel, A. (2008). Testing the Senior Exercise Self-efficacy Project (SESEP) for use with urban dwelling minority older adults. *Public Health Nursing, 25*, 221-234. doi:10.1111/j.1525-1446.2008.00699.x

Resnick, B., Ory, M. G., Hora, K., Rogers, M. E., Page, P., Bolin, J. N.,…Bazzarre, T. L. (2008). A proposal for a new screening paradigm and tool called Exercise Assessment and Screening for You (EASY). *Journal of Aging and Physical Activity, 16*, 215-233.

Resnick, B., Shaughnessy, M., Galik, E., Scheve, A., Fitten, R., Morrison, T.,…C. (2009). Pilot testing of the PRAISEDD intervention among African American and low-income older adults. *Journal of Cardiovascular Nursing, 24*, 352-361.

Rhodes, R. E., Martin, A. D., Taunton, J. E., Rhodes, E. C., Donnelly, M., & Elliot, J. (1999). Factors associated with exercise adherence among older adults. *Sports Medicine, 28*, 397-411. doi:10.2165/00007256-199928060-00003

Rikli, R. E., & Jones, C. J. (1999). Development and validation of a functional fitness test for community-residing older adults. *Journal of Aging and Physical Activity, 7*, 129-161.

Rikli, R. E., & Jones, C. J. (2001). *Senior Fitness Test manual*. Champaign, IL: Human Kinetics.

Schutzer, K. A., & Graves, B. S. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine, 39*, 1056-1061. doi:10.1016/j.ypmed.2004.04.003

Seguin, R., & Nelson, M. E. (2003). The benefits of strength training for older adults. *American Journal of Preventive Medicine, 25*, 141-149. doi:10.1016/S0749-3797(03)00177-6

Seynnes, O., Fiatarone Singh, M. A., Hue, O., Pras, P., Legros, P., & Bernard, P. L. (2004). Physiological and functional responses to low-moderate versus high-intensity progressive resistance training in frail elders. *Journal of Gerontology: Medical Sciences, 59*, M503-M509. doi:10.1093/gerona/59.5.M503

Sheikh, J. I., & Yesavage, J. A. (1986). Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clinical Gerontologist, 5,* 165-172.

Singh, N. A., Clements, K. M., & Singh, M. A. (2001). The efficacy of exercise as a long-term anti-depressant in elderly subjects: A randomized, controlled trial. *Journals of Gerontology: Medical Sciences, 56*, M497-M504.

Smedley, B. D., & Syme, S. L. (2001). Promoting health: intervention strategies from social and behavioral research. *American Journal of Health Promotion, 15*, 149-166.

Starling, R. D., Matthews, D. E., Ades, P. A., & Poehlman, E. T. (1999). Assessment of physical activity in older individuals: A doubly labeled water study. *Journal of Applied Physiology, 86,* 2090-2096.

Sullivan, D. H., Roberson, P. K., Smith, E. S., Price, J. A., & Bopp, M. M. (2007). Effects of muscle strength training and megastrol acetate on strength, muscle mass, and function in frail older people. *Journal of the American Geriatric Society, 55*, 20-28. doi:10.1111/j.1532-5415.2006.01010.x

Thompson, P. D., Buchner D., Pina, I. L., Balady, G. J., Williams, M. A., Marcus, B. H.,…Wenger, N. K. (2003). Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: A statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation, 107,* 3109-3116. doi:10.1161/01.CIR.0000075572.40158.77

Topolsky, T. D., LoGerfo, J., Patrick, D. L., Williams, B., Walwick, J., & Patrick, M. B. (2006). The Rapid Assessment of Physical Activity (RAPA) among older adults. *Preventing Chronic Disease, 3*, A118.

Toraman, N. F., Erman, A., & Agyar, E. (2004). Effects of multi-component training on functional fitness in older adults. *Journal of Aging and Physical Activity, 12*, 538-553.

Tudor-Locke, C. E., & Myers, A. M. (2001). Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Medicine, 31*, 91-100.

U.S. Department of Health and Human Services. (2008). *2008 physical activity guidelines for Americans.* Retrieved from www.health.gov/paguidelines

Van Roie, E., Delecluse, C., Opdenacker, J., De Bock, K., Kennis, E., & Boen, F. (2010). Effectiveness of a lifestyle physical activity versus a structured exercise intervention in older adults. *Journal of Aging and Physical Activity, 18*, 335-352.

Wallace, J. I., Buchner, D. M., Grothaus, L., Leveille, S., Tyll, L., LaCroix, A. Z., & Wagner, E. H. (1998). Implementation and effectiveness of a community-based health promotion program for older adults. *Journal of Gerontology: Medical Sciences, 53*, M301-M306.

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal, 174*, 801-809. doi:10.1503/cmaj.051351

Ware, J. E., Kosinski, M., & Keller, S. (1996). SF-12: A 12-item short-form health survey. *Medical Care, 34*, 220-233.

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item Short-Form health survey (SF-36): I. Conceptual framework and item selection. *Medical Care, 30*, 473-83.

World Health Organization (2010). Global recommendations on physical activity for health. Retrieved from http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf

Worm, C. H., Vad, E., Puggaard, L., Stovring, H., Lauritsen, J., & Kragstrup, J. (2001). Effects of a multicomponent exercise program on functional ability in community-dwelling, frail older adults. *Journal of Aging and Physical Activity, 9,* 412-424.

Yan, T., Wilbur, K. H., Aguirre, R., & Trejo, L. (2009). Do sedentary older adults benefit from community-based exercise? Results from the Active Start program. *The Gerontologist, 6*, 847-855.