

THE ROLE OF CONTROL BELIEFS IN PREDICTING PHYSICAL ACTIVITY
AMONG *ACTIVE LIVING EVERY DAY* PARTICIPANTS WITH ARTHRITIS

By
Nina Rachel Sperber

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Health Behavior and Health Education of the School of Public Health.

Chapel Hill
2009

Approved by:

Brenda DeVellis, Ph.D. (Chair)

Robert DeVellis, Ph.D.

Megan Lewis, Ph.D.

Leigh Callahan, Ph.D.

Chris Wiesen, Ph.D.

©2010
Nina Rachel Sperber
ALL RIGHTS RESERVED

ABSTRACT

Nina Rachel Sperber: The role of control beliefs in predicting physical activity among *Active Living Every Day* participants with arthritis

(Under the direction of Brenda DeVellis (Chair), Leigh Callahan, Robert DeVellis, Megan Lewis, Chris Wiesen)

Physical activity promotion constitutes an important public health approach to managing arthritis, the leading cause of disability in the US. Many people with arthritis have good outcomes with lifestyle physical activity. However, we do not know why some fare better than others. Perceived control over exercise ability and outcomes have predicted physical activity in other studies, but less is known about how these beliefs relate to physical activity within the context of arthritis. I explored the role of these factors in predicting physical activity among participants with arthritis in *Active Living Every Day (ALED)*, a theory-informed lifestyle physical activity program originally designed for people without arthritis.

I analyzed baseline and post-test data of the intervention group from an evaluation of *ALED* for people with arthritis. Candidate predictors were depressive symptoms, physical symptoms, and control beliefs (helplessness, arthritis and exercise self-efficacy, and exercise outcome expectations). Hierarchical linear regression was used to examine baseline predictors of post-intervention physical activity and function. A second analytic approach used

multiple mediation to test relationships posited in Social Cognitive Theory. I examined whether physical and depressive symptoms affected physical activity via exercise and arthritis symptom self-efficacy and whether outcome expectations mediated between these types of self-efficacy and physical activity. The final analyses replicated these mediation analyses but with only post-test measures of efficacy and outcome expectations.

The final sample consisted of 143 intervention participants. Their mean age was 68 years, and the majority were female (86%) and white (75%). Slightly more than half (55%) had above a high school education. Control beliefs emerged as influential beyond arthritis symptoms in both the hierarchical regression and mediation analyses. Post-test outcome expectations also significantly mediated the relationship between baseline self-efficacy and post-test physical activity. Higher education predicted more physical activity. Depressive symptoms did not predict physical activity.

Because control beliefs at both the beginning and end of the intervention were important predictors of physical activity outcomes, even more attention needs to be given to them in interventions directed at people with arthritis. Lifestyle physical activity interventions for people with arthritis might be more effective with greater attention given to cognitive behavioral techniques for both exercise and symptom management. Additionally, program material that meets needs of those with less formal education could yield better outcomes for more participants.

TABLE OF CONTENTS

LIST OF TABLES.....	vii
LIST OF FIGURES.....	ix
1. INTRODUCTION	1
OVERVIEW	1
STUDY PURPOSE AND AIMS	3
2. LITERATURE REVIEW	5
EPIDEMIOLOGY OF ARTHRITIS	5
PHYSICAL ACTIVITY RECOMMENDATIONS FOR MANAGING ARTHRITIS.....	6
PREDICTORS OF PHYSICAL ACTIVITY FOR PEOPLE WITH ARTHRITIS.....	11
<i>Demographic and other characteristics</i>	11
<i>Depression and arthritis symptoms</i>	12
<i>Control beliefs</i>	14
PHYSICAL ACTIVITY INTERVENTIONS FOR PEOPLE WITH ARTHRITIS	17
ACTIVE LIVING EVERY DAY (ALED)	19
<i>Description of program</i>	19
<i>Evidence of program efficacy</i>	22
<i>Evaluation for people with arthritis</i>	24
3. METHODOLOGY	27
RESEARCH AIMS AND HYPOTHESES	27
STUDY DESIGN AND SETTING	30

SAMPLE AND RECRUITMENT	30
DATA COLLECTION	32
ATTRITION AND MISSING DATA	33
MEASURES	36
<i>Dependent variables</i>	36
<i>Predictor variables</i>	39
<i>Demographic and comorbidity variables</i>	42
ANALYSIS STRATEGY	43
<i>Missing Data</i>	43
<i>Analysis for Specific Aim 1</i>	44
<i>Analysis for Specific Aims 2 and 3</i>	45
4. RESULTS	49
DESCRIPTION OF THE STUDY SAMPLE.....	49
RESULTS FOR AIM 1	55
RESULTS FOR AIM 2	71
RESULTS FOR AIM 3	73
5. DISCUSSION	76
SUMMARY	76
CONTROL BELIEFS RELATED TO PHYSICAL ACTIVITY.....	77
POST-TEST OUTCOME EXPECTATIONS.....	80
EDUCATION AND PHYSICAL ACTIVITY	81
RELEVANCE OF DEPRESSIVE SYMPTOMS	84
LIMITATIONS AND STRENGTHS	86
6. CONCLUSION.....	89
7. LITERATURE CITED	93

LIST OF TABLES

Table 1. Summary of recommendations for aerobic physical activity for people with arthritis.....	8
Table 2. Demographic characteristics and comorbidities of the <i>ALED</i> intervention group.....	50
Table 3. Physical and Depressive Symptoms and Control Belief Variables of <i>ALED</i> Intervention Group.....	52
Table 4. Physical Activity and Function Measures of <i>ALED</i> Intervention Group.....	54
Table 5: Pearson’s correlations for demographic characteristics and comorbidities with post-test physical activity and physical function.....	57
Table 6: Pearson’s correlations for post-test physical activity level and physical function.....	58
Table 7. Pearson’s correlations for baseline arthritis symptoms, depressive symptoms and control beliefs.....	59
Table 8. Pearson’s correlations for baseline arthritis symptoms, depression and control beliefs with post-test physical activity and physical function.....	60
Table 9. Multiple and semi-partial squared correlations obtained in multiple regression analysis predicting self-reported physical activity frequency and caloric expenditure.....	63
Table 10. Multiple and semi-partial squared correlations obtained in multiple regression analysis predicting physical function.....	64
Table 11. Comparison of model fit within each outcome.....	67
Table 12. Multiple regression analysis of self-reported post-test physical activity.....	69
Table 13. Multiple regression analysis of post-test physical function tests.....	70
Table 14. Point estimates and potential indirect effects obtained in multiple regression analysis predicting physical activity frequency: baseline measures of self-efficacy variables.....	72

Table 15. Point estimates and potential indirect effects obtained in multiple regression analysis predicting physical activity frequency: post-test measures of self-efficacy variables.....75

LIST OF FIGURES

Figure 1. Conceptual model for Aim 2.....	28
Figure 2. Alternative conceptual model for Aim 3.....	29
Figure 3. Participant flow chart.....	35
Figure 4. Multiple mediation model.....	47
Figure 5. Single mediation model.....	47

1. INTRODUCTION

Overview

Physical activity is a safe and effective way for adults with arthritis to manage symptoms (2008 Physical Activity Guidelines Advisory Committee, 2008; Nelson et al., 2007). Recent recommendations state that individuals with arthritis should aim for a total of 150 minutes of moderate intensity activity per week in at least 10-minute episodes to see improved functioning, reduced symptoms, and improved quality of life (2008 Physical Activity Guidelines Advisory Committee, 2008; Nelson et al., 2007). However, according to the 2002 National Health Interview Survey, after age adjustment, 37% of adults with arthritis were inactive, *i.e.*, they did not participate in any level of physical activity for at least ten minutes per occasion. In response to this, the Centers for Disease Control and Prevention Arthritis Program has recommended a variety of physical activity programs for people with arthritis (National Center for Chronic Disease Prevention and Health Promotion, 2009).

Although many people with arthritis have had good outcomes from participating in recommended programs, we do not know why some participants have fared better than others. These programs need to be effective for as many people as possible in order to maximize limited resources. Thus, we need information on how to more effectively target physical activity programs to those people with arthritis who have a greater risk for low activity levels (Fontaine &

Haaz, 2006; Theis, Helmick, & Hootman, 2007). This dissertation responded to this knowledge gap by exploring factors related to increased physical activity among people with arthritis who participated in one non arthritis-specific program, *Active Living Every Day (ALED)*.

ALED is a theory-informed lifestyle physical activity program that has been shown to help some sedentary individuals become and stay physically active through the development of cognitive and behavioral skills (Dunn et al., 1999). The focus of this program is on increasing moderate intensity physical activity in one's daily life. *ALED* consists of a 20-week program in which participants meet weekly for an hour in small groups to discuss ways to identify and overcome barriers to physical activity. The weekly discussions are structured around a textbook, with chapters organized according to steps that individuals can take to become active.

Because the original evaluation of the *ALED* program excluded people with arthritis (Dunn et al., 1999), a study began in February 2004 to determine its effectiveness for this population at high-risk for physical inactivity. That original study consisted of a 20-week randomized controlled trial in 17 community-based sites in North Carolina in which participants (N=339) were randomized into groups receiving either the intervention or usual care. Analyses showed a statistically significant improvement in the mean baseline physical activity level compared to control participants, immediately following and up to one year after the intervention. Furthermore, intervention participants improved on some functional mobility measures after the intervention.

Study purpose and aims

Because the parent study had demonstrated that the intervention resulted in improved physical activity outcomes overall, I wanted to take a more nuanced look at factors that were instrumental in predicting participants' physical activity and function at the end of the intervention. I was interested first in learning more about those characteristics prior to the intervention that best explained outcomes at the end. Secondly, I wanted to examine a process that theoretically would affect participants' post-intervention physical activity. I investigated this question by testing if perceived control over both exercise and symptoms, factors amenable to change, might mitigate the influence of symptoms on physical activity behavior.

In the first aim, characteristics of interest were those that have been regarded as influential for physical activity among people with arthritis, including demographic and comorbid characteristics, depressive and arthritis symptoms, and control beliefs. Little has been done to understand how depressive and arthritis symptoms influence physical activity within the context of an intervention. Cross-sectional research has shown that depressive and arthritis symptoms are barriers to physical activity, and these variables are more frequently investigated as outcomes rather than predictors in longitudinal physical activity studies. Additionally, beliefs about personal control are known to be predictive of physical activity outcomes but not frequently studied within the context of both arthritis and depressive symptoms.

In the second aim, a theoretical model was tested to assess whether control beliefs, consisting of self-efficacy and outcome expectations, mediated a relationship between symptoms and physical activity. Physical and affective states, including arthritis and depressive symptoms, can theoretically have a bearing on one's physical activity by affecting the strength of his or her self-efficacy. However, these influences on self-efficacy are less often studied (Motl, Snook, McAuley, & Gliottoni, 2006). One's expectations about outcomes can also affect physical activity behavior. It is theorized that this relationship depends on the strength of one's self-efficacy, but this hypothesis is not often tested with empirical research. By comparing mediation models with control beliefs measured at the beginning versus the end of the intervention, we were able to obtain more information on not only how but also when these control beliefs together influenced physical activity. The results from this dissertation helped to elucidate more detail about factors related to better physical activity outcomes in a non arthritis-specific intervention recommended for people with arthritis.

2. LITERATURE REVIEW

Epidemiology of arthritis

Arthritis is the leading cause of disability in the US, affecting 43 million adults and costing \$86 billion annually, and its prevalence and costs will increase as the population ages (Centers for Disease Control and Prevention (CDC), 2006; Hootman & Helmick, 2006). The term *arthritis* refers to a group of more than 100 medical conditions with various causes. Generally, arthritis affects the musculoskeletal system, and specifically the joints, leading to pain, stiffness, and movement problems. These symptoms frequently interfere with daily tasks such as walking, climbing stairs, using a keyboard, cutting food or brushing teeth.

Osteoarthritis, rheumatoid arthritis, and fibromyalgia are among the most common forms of arthritis (Issa & Sharma, 2006; Arthritis Foundation, 1999). Osteoarthritis involves degeneration of cartilage in the joints and most often affects the hand, knee, hip and spine, leading to pain, stiffness, and activity limitations. Some estimate that osteoarthritis is present in at least one joint in more than half of all people aged 65 or older (McIlvane, Schiaffino, & Paget, 2007). Rheumatoid arthritis is an autoimmune disease that involves chronic inflammation of the joint lining. This condition can lead to inflammation in other joint tissues and organs and, in turn, disability or mortality (Rasch, Hirsch, Paulose-Ram, & Hochberg, 2003). Rheumatoid arthritis has been estimated to affect about two percent of adults in the US ages 60 years and older.

Fibromyalgia has its roots in the central nervous system and is characterized by widespread and chronic pain throughout the muscles and tenderness in at least 11 of 18 defined tender points. Severe fatigue is also a common symptom, starting in the morning despite adequate sleep and worsening by mid-afternoon (Mease, 2005).

In general, the prevalence of arthritis increases with being female, older, of non-Hispanic white or non-Hispanic black race/ethnicity, physically inactive, overweight or obese (i.e., having a body mass index ≥ 25.0), and having less than a high school education (Centers for Disease Control and Prevention (CDC), 2001; Centers for Disease Control and Prevention (CDC), 2002).

Physical activity recommendations for managing arthritis

The many forms of arthritis do not have one-size fits all treatments, and individualized and ongoing treatment plans aim to manage symptoms, providing relief so that patients may function at normal or near normal levels (Bykerk & Keystone, 2005; Holman & Lorig, 2004). Regular physical activity can help many people manage their arthritis symptoms by improving physical function and quality of life (2008 Physical Activity Guidelines Advisory Committee, 2008; Shih, Hootman, Kruger, & Helmick, 2006; Suomi & Collier, 2003). Thus, increasing physical activity levels among people with arthritis was identified as a national public health priority in the *Healthy People 2010* health objectives for physical activity and fitness (U.S. Department of Health and Human Services, 2000). Additionally, the CDC has promoted physical activity for people with arthritis with

a health communication campaign for use by state health departments called, *Physical Activity, The Arthritis Pain Reliever* (Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, 2008).

Guidelines recently released by the US Department of Health and Human Services (DHHS) and, separately, the American College of Sports Medicine/American Heart Association (ACSM/AHA) specify recommended amounts of physical activity for accruing health benefits (2008 Physical Activity Guidelines Advisory Committee, 2008; Nelson et al., 2007). Table 1 summarizes the current guidelines for aerobic activity along with earlier recommendations from *Healthy People 2010* and an arthritis expert workgroup.

Table 1: Summary of recommendations for aerobic physical activity for people with arthritis

Organization	Year	Intensity	Frequency and duration	Total per week
Department of Health and Human Services PA Guidelines*	2008	Moderate	150 minutes over one week (2.5 hrs)	150 minutes
		Vigorous	75 minutes over one week (1.25 hrs)	75 minutes
American College of Sports Medicine/ American Heart Association	2008	Moderate	5 days a week for 30 minutes each day	150 minutes
		Vigorous	3 days a week for 20 minutes each day	60 minutes
Healthy People 2010**	2006	Moderate	5 days a week for 30 minutes each day	150 minutes
		Vigorous	3 days a week for 20 minutes each day	60 minutes
Expert workgroup from the Exercise and Physical Activity Conference in St. Louis	2002	Moderate	For adults with hip/knee osteoarthritis: 3 days a week for 30 minutes each day	90 minutes
		60-85% maximal heart rate, progressively adjusted	For adults with rheumatoid arthritis: 2-3 times a week for 30-60 minutes each day	60-180 minutes

*Can do an equivalent combination of moderate and vigorous intensity activity.

**Based on mid-course revisions.

Both the DHHS and the ACSM/AHA guidelines are based on the latest scientific evidence and are consistent with each other (American College of Sports Medicine, 2008). The DHHS guidelines recommend that adults aim for at least 150 minutes (2 hours and 30 minutes) of moderate-intensity aerobic physical activity, 75 minutes (1 hour and 15 minutes) of vigorous-intensity

activity, or an equivalent combination of moderate and vigorous intensity physical activity a week (2008 Physical Activity Guidelines Advisory Committee, 2008). The ACSM/AHA guidelines suggest performing moderate-intensity aerobic physical activity for a minimum of 30 minutes on five days each week or at a vigorous-intensity level for a minimum of 20-minutes on three days each week. Both sets of guidelines suggest that, at a minimum, this activity should be performed in at least 10-minute episodes, preferably spread throughout the week to reduce risk of injury and fatigue. All types of moderate or vigorous intensity aerobic activity, whether walking the dog or biking to the store, count toward the guidelines.

Recommendations for muscle strengthening activities are to do activities that are moderate or high intensity and involve all major muscle groups on two or more days a week (2008 Physical Activity Guidelines Advisory Committee, 2008; American College of Sports Medicine, 2008). The DHHS guidelines recommend that older adults do one to three sets of eight to 12 repetitions each, reaching the point where it's hard to do another repetition without help. Activities should work all major muscles groups, and the type of activity can vary, from lifting weights to heavy gardening. The ACSM recommends performing 8-10 exercises each week to work all of the major muscle groups.

Both the DHHS and the ACSM/AHA guidelines state that the intensity level of aerobic and muscle strengthening activities should be determined relative to one's own fitness level. The ACSM defines moderate intensity as a 5 or 6 on a scale of 1 to 10. Moderate intensity aerobic activity should produce noticeable

increases in heart rate and breathing, and, by this definition, can mean a slow walk for some or a brisk walk for others. Vigorous intensity, measured on the same scale, is a 7 or 8 and, for aerobic activity, produces large increases in heart rate and breathing.

Individuals, however, are the authorities on how therapies such as physical activity affect them, and they must take a self-initiated and active role in applying that knowledge to their lives (Holman & Lorig, 2004). Experts assert that adults with chronic conditions should tailor activity recommendations to their physical abilities. Additionally, older adults who cannot meet the minimum recommended goals should do as much physical activity as possible. For example, a person with moderate severity arthritis could adjust the number of aerobic activity days to 3-5 and conduct strength training every other day (Nelson et al., 2007). Evidence indicates that some physical activity is better than none, and both guidelines state that exceeding minimum recommended amounts will provide additional health benefits. For those not active at recommended levels, a plan should include a gradual approach for increasing physical activity over time using multiple bouts, at least 10 minutes in duration.

Although physical activity is considered a safe and effective way to control the disease consequences of arthritis, the majority of people with arthritis have failed to meet public health recommendations (Callahan, 2009). According to the 2002 National Health Interview Survey, after adjusting for age, more than one-third (37%) of adults with arthritis were inactive, that is, never participating in light, moderate, or vigorous physical activity for at least ten minutes per occasion

(Shih, Hootman, Kruger et al., 2006). This rate of inactivity was similar to those found among people without arthritis. However, adults with arthritis were significantly less likely than adults without arthritis to participate in Healthy People 2010 recommended levels of moderate or vigorous activity (30% of people with arthritis and 33% of people without arthritis, $p=.05$) (Shih, Hootman, Kruger et al., 2006). Thus, we need information that can be used to more effectively target programs for people with arthritis so that more participants will have better outcomes (Fontaine & Haaz, 2006; Theis et al., 2007). This dissertation sheds light on how characteristics predictive of physical activity among people with arthritis relate to physical activity outcomes within the context of a lifestyle physical activity intervention.

Predictors of physical activity for people with arthritis

Demographic and other characteristics

According to the 2004 Behavioral Risk Factor Surveillance System (BRFSS) data, which asked about the presence of doctor-diagnosed arthritis, increased education was the most important predictor of exercise or physical activity during the previous month. Other factors were being male, having received advice by a health professional to do exercise or be physically active, and having taken an arthritis education course. Factors related to lack of exercise or physical activity within the past month were poorer self-reported general health, obesity, age of 65 years or older, black race, and self-reported physical limitations (Fontaine & Haaz, 2006).

The 2002 National Health Interview Survey asked respondents about frequency and duration of moderate and vigorous physical activities and found that the highest prevalence of inactivity was among adults with arthritis who had (1) four or more functional limitations (for example, could not walk a quarter mile or up ten steps), (2) one or more social/leisure limitations, (3) a need for special equipment, and (4) poor access to a fitness facility (Shih, Hootman, Kruger et al., 2006). Stratifying by gender, factors associated with inactivity in men and women with arthritis were older age (≥ 45 years in men, ≥ 65 years in women), less education, functional limitations, and lack of access to a fitness program/facility. Among women but not men, inactivity was also associated with being Hispanic or a non-Hispanic black, having frequent anxiety/depression (determined by the question, "During the past 12 months, have you been frequently depressed or anxious?"), one or more social/leisure limitations, a need for special equipment, and never receiving arthritis-related physical activity counseling. Among men but not women, inactivity was also associated with severe joint pain (Shih, Hootman, Kruger et al., 2006).

Depression and arthritis symptoms

The prevalence of depression among people with arthritis is higher than in the general population and comparable to people with other chronic conditions (DeVellis, 1995; Dickens, McGowan, Clark-Carter, & Creed, 2002).

Approximately 26% (33% in women and 23% in men) of people with arthritis, regardless of age, reported in the 2002 National Health Interview Survey having

frequent anxiety or depression (Theis et al., 2007). Based on the 2001 BRFSS, people with arthritis and frequent mental distress, defined as having stress, depression or problems with emotions for 14 or more of the past 30 days, were more likely to be female, Hispanic, have less than a high school education, and be insufficiently active (relative to the recommended activity level at that time) or inactive (Strine et al., 2004). Although many people with arthritis experience depression over the course of their illness, a cross-sectional snapshot may not capture the scope of the problem. A recent longitudinal study found that the cumulative risk of self-reported depression in patients with RA was 40% at 9 years of follow-up compared to a 15% cross-sectional prevalence within that sample, indicating that most of the cases may diminish or be intermittent (Wolfe & Michaud, 2009).

Depression among people with arthritis has been associated with physical symptoms of pain and fatigue (Dickens et al., 2002; Goldenberg, 2009; Rosemann et al., 2007). Wolfe and Michaud (2009) found in a longitudinal study that fatigue and pain together were the most important predictors of self-reported depression. Furthermore, the cumulative risk of depression increased with more symptom severity. The relationship between depression and pain is bidirectional. When people are depressed their ability to cope with pain is reduced, and the more pain that they have, the more likely they are to be depressed (Covic, Tyson, Spencer, & Howe, 2006; Goldenberg, 2009; Shih, Hootman, Kruger et al., 2006). The same relationship has been found between depression and physical limitations (Rosemann et al., 2007). A systematic literature review found that bio-

psychological mechanisms including genetic factors and brain morphology potentially explained a link between pain and depression among people with fibromyalgia (Goldenberg, 2009).

Physical symptoms and depression have been reported in cross-sectional studies as major barriers to physical activity among older adults and people with arthritis (Brawley, Rejeski, & King, 2003; DeVellis, 1995; Singh, 2004). However, few studies have examined the relation of prior arthritis symptoms and depression to physical activity within the context of an intervention, which would assure temporality of the association. This study addresses this gap.

Control beliefs

The onset of arthritis and depression can adversely affect one's ability to do former activities, making personal control an important target for health promotion among older adults (Marquez, Bustamante, Blissmer, & Prohaska, 2009). Despite these unsolicited changes in later life, individuals can maintain a sense of control over their lives by choosing activities that they regard as potentially attainable and beneficial. Furthermore, having positive expectations about these activities can motivate individuals to take action in the present (Bandura, 1999). The concepts of self-efficacy, outcome expectations and perceived helplessness represent some of these anticipatory beliefs about personal control.

Social Cognitive Theory: self-efficacy and outcome expectations

Social Cognitive Theory constructs of self-efficacy and outcome expectations have been shown to influence physical activity among adults with arthritis (Lewis, Marcus, Pate, & Dunn, 2002; Lorig & Holman, 2003; Oliver & Cronan, 2005) and inform effective physical activity programs (Kahn et al., 2002). Outcome expectations are beliefs that behavior probably will or will not result in certain outcomes, including anticipated (1) positive or negative physical effects, (2) social reactions, or (3) self-evaluations (Bandura, 1997). Self-efficacy reflects one's beliefs about his or her ability to realize an outcome and can be affected by mastery experiences, vicarious experience, verbal persuasion, and physical and mental states (Bandura, 1997; DeVellis & DeVellis, 2001). The latter influence is particularly relevant in the realms of arthritis and physical activity, for arthritis-related pain and depression can inhibit one's performance and lead to perceived inefficacy (Motl et al., 2006).

According to Bandura, self-efficacy can shape behavior directly or by influencing expected outcomes (Bandura, 1997). Those with high self-efficacy expect to attain favorable outcomes, and those with low self-efficacy expect that their actions will result in unfavorable outcomes (Bandura, 2004). Bandura asserts that outcome expectations will add little beyond self-efficacy toward explaining an outcome that is highly contingent on performance. For example, marathon runners with confidence in their ability to compete will expect to have a successful marathon outcome. By the same token, when outcomes are not entirely determined by a person's individual abilities (e.g., environmental

barriers), outcome expectancies may be important independent predictors of behavior (Maddux, 1995b).

Although Bandura depicts outcome expectations as mostly dependent on self-efficacy, definitive empirical evidence about this relationship is lacking (Maddux, 1995a; McAuley et al., 2007). Many studies have supported the notion that self-efficacy influences outcome expectations (Maddux, 1995a), and studies with older adults have shown that outcome expectations account for at least some variation in physical activity beyond that accounted for by self-efficacy (Resnick, 2001; Williams, Anderson, & Winett, 2005). However, the concepts have by and large not been defined and measured with consistency (Maddux, 1995a). For example, some studies have not clearly distinguished between an expectation about a general goal attainment (Exercise makes people feel better physically.) and an expectation dependent one's performance (I will feel better physically if I exercise.) (Kirsch, 1995). Attention to these operational distinctions can inform a rationale for including both outcomes expectations and self-efficacy as predictors of behavior.

Helplessness

Just as perceived control over health can influence health behavior, so can a perceived lack of control. The concept of helplessness, a belief that nothing can be done to effect change, reflects this perception. Helplessness is characterized by a lack of motivation (Backman, 2006), and, among people with arthritis, has correlated with less physical activity and reduced medication

adherence (Edwards, Bingham, Bathon, & Haythornthwaite, 2006).

Helplessness has also independently been associated with increased arthritis pain (Backman, 2006).

Much like self-efficacy, helplessness beliefs are potentially amenable to cognitive-behavioral therapy. These techniques can strengthen one's assessment about his or her ability to deal with arthritis pain (Edwards et al., 2006). A connection between helplessness and self-efficacy is supported by evidence of an association between pain catastrophizing, which includes helplessness, and other self-evaluation processes, such as self-efficacy for controlling pain (Quartana, Campbell, & Edwards, 2009). Thus, although physical activity may increase arthritis pain the short run, improved self-efficacy and helplessness beliefs may positively impact a person's experience with symptoms over the long run. Appreciation of the benefit of physical activity for people with arthritis may thus require a longer-term perspective.

Physical Activity Interventions for People with Arthritis

Interventions can help people with arthritis manage some of these factors that might prevent them from being active; however, data on whether individuals prefer arthritis-specific versus non-specific programs are mixed. The Arthritis Foundation found, through qualitative research, that people with arthritis generally prefer to attend mainstream wellness programs, rather than those that label them as having arthritis (Boutaugh, 2003). However, a more recent 2007 report by the Arthritis Foundation found that people with arthritis and fewer than

three comorbidities preferred arthritis-specific approaches (Callahan, 2009). The CDC has thus recommended a variety of resources, some arthritis-specific and others not, shown to be effective for people with arthritis (Callahan, 2009).

Regardless of whether programs are specific to people with arthritis or not, physical activity programs with behavior change components have resulted in increased physical activity frequency among people with arthritis (2008 Physical Activity Guidelines Advisory Committee, 2008; Callahan, 2009). A recent meta-analysis of physical activity interventions among people with arthritis found a moderate increase in mean physical activity level, with problem solving for primarily joint discomfort or fatigue the most frequent behavior change strategy employed (Conn, Hafdahl, Minor, & Nielsen, 2007). A randomized controlled trial of *Fit and Strong!*, a multicomponent program for people with arthritis that uses strategies such as providing feedback on participants' progress, found that, among participants with lower extremity osteoarthritis, minutes of exercise per week increased immediately following the intervention and were maintained 6 and 12 months later (Hughes et al., 2004). Additionally, two arthritis-specific exercise programs recommended by the CDC, the Arthritis Foundation Exercise Program [formerly called People With Arthritis Can Exercise (PACE)] and the Arthritis Foundation Aquatic Program (AFAP), include group problem solving, commonly focusing on arthritis symptoms as barriers for physical activity.

Lifestyle programs, which teach strategies to incorporate physical activity into one's daily life, may be appealing for people with arthritis. A feature that distinguishes these physical activity programs is that activities are self-selected

rather than prescribed. Individuals with varying manifestations of symptoms can choose activities that they feel most comfortable with and are likely to stay with over time (Dunn et al., 1998b). There is evidence that participation in lifestyle programs by the general population has increased moderate-intensity physical activity and reduced sedentary behavior for the long-term (Dunn, Andersen, & Jakicic, 1998). These programs also typically provide opportunities to meet in a group context, providing participants with social support for solving problems such as difficulty moving in the face of pain or fatigue. Finally, by encouraging accumulation of physical activity in shorter bouts, lifestyle programs provide the ability to alternate activity with periods of rest. This approach follows the American College of Sports Medicine's recommendation that people with arthritis begin to exercise slowly, progress gradually and adapt physical activities to individual needs (McGraw, McGraw, & American College of Sports Medicine, 2003).

Active Living Every Day (ALED)

Description of program

ALED is a theory-informed lifestyle physical activity course that has been shown to help some sedentary individuals become and stay physically active through the development of cognitive and behavioral skills (Blair, Dunn, Marcus, Carpenter, & Jaret, 2001) and recently recommended by the CDC for people with arthritis (Callahan, 2009). This program was developed jointly by the Cooper Institute, Brown University and Human Kinetics publishers. *ALED* consists of a

20-week course on behavior change for a general adult audience delivered through community organizations. Program components are weekly small group sessions, a textbook, an online study guide, and a support Web site. *ALED* emphasizes moderate-intensity activity, fitting activity into life, and personalizing physical activity programs. *ALED* can be delivered in several different ways: 1) classroom format with a printed study guide (or textbook), 2) classroom format with an online study guide, and 3) independent study with an online study guide. These various delivery options provide flexibility to meet a range of needs.

The classroom format with a printed study guide option consists of weekly hour-long group meetings with individual reading and work between sessions. Participants receive the *ALED* book (Blair et al., 2001) and weekly handouts. The sessions and handouts teach participants skills to successfully integrate physical activity into their daily lives. These skills include identifying and overcoming barriers to activity, realistic goal setting, creating social support, using motivational techniques, and preventing relapse. Typical group sessions use the following format: door prize, check-in and review, facilitated discussion, group activity, homework assignment, preview, summary, participant evaluation, and optional refreshments. The check-in and review allows participants to share their successes and challenges over the week, providing information that can be used to tailor the session to participants' needs. The facilitated discussion is based on the week's lesson material. Group activities are designed to help participants discover how to apply the weekly lesson materials. For example, an activity for the lesson on barriers and benefits would have participants identify

barriers and benefits to becoming more physically active and select at least one barrier that they will work on during the next week. Homework assignments provide an opportunity for participants to practice the behavior skills that they learn in class. For example, an assignment for the benefits and barriers lesson is to complete a list of personal benefits and barriers that come up during the week. The preview of the next session aims to entice participants to return, and the summary highlights the main points of the session. Participants are asked to evaluate every session, and the regular feedback can provide information to help tailor the session to their likes and dislikes and determine whether their needs are being met.

The classroom format with the online study guide option (*ALED Online*) includes an interactive online study guide, tailored to stage of readiness, for completing work between sessions. The online study guide enhances the textbook/group sessions. It houses forms, weekly quizzes, Web links, and suggested readings to help broaden understanding of the week's topic. *ALED Online* also includes tools to help track progress such as an activity minutes log; the 1000+ plan, which helps find ways to burn 1000 extra calories/week; a steps log; short and long-term goal log; and a walk test.

The independent study with online study guide option was designed for people who do not want or are not able to complete the course in a classroom setting. The online study guide takes the place of the classroom with a virtual buddy, matched to individual stage of readiness to change, who leads participants through the work. This option also includes links to activity-related

topics and is enhanced with face-to-face, phone, or e-mail coaching sessions at strategic intervals during the course.

The program participant package is available through the Active Living Partners program <<http://www.activeliving.info/takecourse.cfm>>, a division of Human Kinetics publishers of educational programs and tools to help people adopt and maintain healthy lifestyles. This package includes Web-based support, the textbook, and *ALED Online*. The Active Living Partners Web site provides support to both participants and providers, including marketing information, a data tracking system, and up-to-date research on physical activity and health behavior change. Human Kinetics serves as the national education and support center that coordinates Active Living Partners facilitator and director training and the Web-based support.

Evidence of program efficacy

ALED derived from a scientific study, *Project Active*, which was conducted jointly by the Cooper Institute and Brown University (Dunn et al., 1998; Dunn et al., 1999; Kohl, Dunn, Marcus, & Blair, 1998). Project Active was a two-year randomized trial to compare the effectiveness of this lifestyle intervention with a traditional structured exercise prescription for increasing physical activity levels and cardiorespiratory fitness. Study participants were 235 healthy sedentary men and women aged 35 to 60 years. Interventions in both groups were based on Social Cognitive Theory and the Stages of Change model. Group leaders helped participants set goals and solve problems. Participants additionally were

given a manual tailored to their level of readiness for change, assessed each month. Participants randomized to the structured group received a traditional exercise prescription and individual supervised sessions. Participants in the lifestyle group were advised to accumulate at least 30 minutes of moderate-intensity physical activity on most, and preferably all, days of the week in a way suited to their lifestyle and their level of readiness for change. They gained knowledge of cognitive and behavioral skills related to physical activity adoption and maintenance through the tailored intervention manual and weekly home assignments.

This study found that lifestyle programs could be as effective as structured exercise prescriptions, with both groups significantly increasing their physical activity levels and cardio-respiratory fitness. The lifestyle group increased their moderate-intensity physical activity more than the structured group at 6 months. However, at 24 months the amount of increase in physical activity and cardio-respiratory fitness was comparable for the two groups (Dunn et al., 1999). Physical activity level varied by gender, with men having higher levels than women (Dunn et al., 1998; Dunn et al., 1999).

Active Living Every Day was disseminated in community settings between 2003 and 2007 as part of the *Active for Life* program, a national quasi-experimental study to evaluate translation and effects of evidence-based programs in community settings over a four-year time period (Wilcox et al., 2008). Participants had to be ≥ 50 years old, sedentary or under active, and free of medical conditions or disabilities that required higher levels of supervision.

Compared to the previous *ALED* efficacy studies, participants in *Active for Life* were less economically advantaged and more ethnically diverse. All of the changes in outcomes, including moderate and vigorous physical activity and depressive symptoms, were significant except for the reduction in depression for the Year 3 carry forward analysis, in which baseline values for those who did not return posttest surveys were carried forward (Wilcox et al., 2008). A secondary analysis examining changes in moderate to vigorous physical activity by baseline predictor variables found that statistically significant increases in physical activity were associated with female gender, Hispanic/Latino ethnicity, a higher pretest BMI, more health conditions, osteoporosis, or lower pretest physical activity. Those with more than a high school education and hypertension were also more likely to increase physical activity, but the difference was not statistically significant ($p < .10$) (Wilcox et al., 2009).

Evaluation for people with arthritis

Because the original evaluation of the *ALED* program excluded people with arthritis (Dunn et al., 1999), a study began in February 2004 to determine its effectiveness for this population at high-risk for physical inactivity. All participants received the *ALED* book and a pedometer, used outside of class for motivation and monitoring of steps. If participants had access to the Internet, they received an online study guide when they registered for the program. If they chose to be independent learners, they could take the course online rather than participating

in the classes. More details about the study design are described in the methodology section of this dissertation.

Analysis of the effectiveness of *ALED* for people with arthritis showed a statistically significant improvement in the mean baseline physical activity level compared to control participants immediately after and for as long as one year following the intervention (Callahan et al., 2006). Participants, in qualitative analysis, reported that they were satisfied with the program and thought that it was appropriate for people with arthritis. They particularly liked the features of being able to exercise “bit by bit” and have social support. Pain was the main barrier to exercise reported by these participants, and instructors and participants suggested incorporating pain management strategies into the instructor training and program content. There was no obvious common theme in responses of participants with moderate or higher amounts of pain and arthritis-related disability (Callahan et al., 2007)

Although *ALED* overall was a success for people with arthritis, some participants were not as successful as others. I extended the evaluation to examine those baseline characteristics that predicted better outcomes among the intervention group. The characteristics selected for investigation were factors that have been regarded as influential for physical activity among people with arthritis but not often studied with a prospective design and within the context of a lifestyle intervention. These factors were demographic and comorbid characteristics, arthritis symptoms, depressive symptoms, and control beliefs. I also explored theoretical relationships between symptoms and control beliefs to

determine how they together predict physical activity for intervention participants. I was interested in examining if physical and psychological states (in this case, arthritis and depressive symptoms) affect physical activity via exercise and symptom self-efficacy. I was also interested in examining if a relationship between these types of self-efficacy and physical activity would be mediated by outcome expectations. These relationships have been posited in theory as important for explaining health behavior.

3. METHODOLOGY

Research aims and hypotheses

Aim 1: To identify baseline predictors of post-test physical activity and physical function for people who participated in the intervention.

Aim 2: To examine whether baseline self-efficacy and, in turn, outcome expectations mediated relationships between baseline pain, fatigue, and depression and post-test self-reported physical activity frequency.

H2.1: There will be a positive correlation between baseline depressive and arthritis symptoms.

H2.2: The lower the baseline measures of depressive and arthritis symptoms, the higher the post-test physical activity frequency.

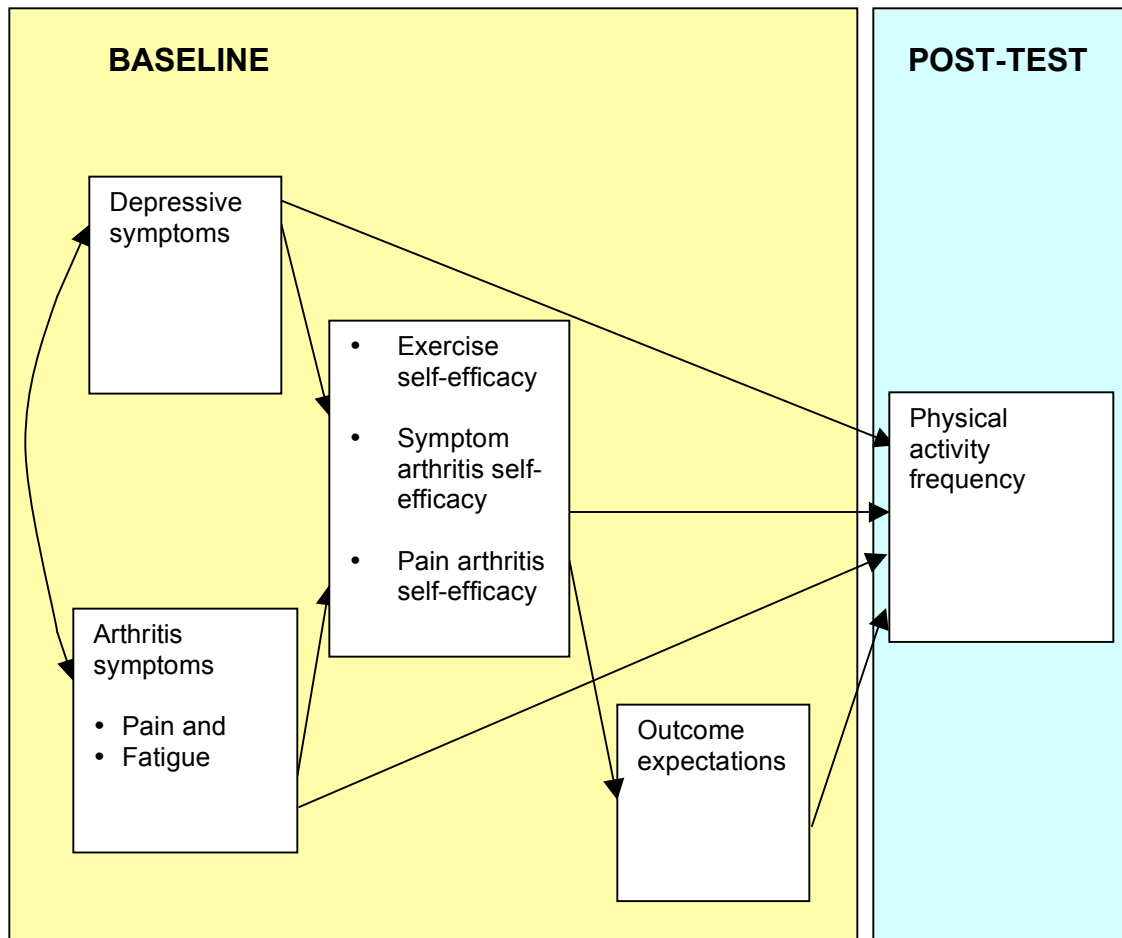
H2.3: The relationship between baseline pain and post-test physical activity frequency will be significantly attenuated by the simultaneous inclusion of baseline exercise and symptom self-efficacy variables

H2.4: The relationship between baseline fatigue and post-test physical activity frequency will be significantly attenuated by the simultaneous inclusion of baseline exercise and symptom self-efficacy variables.

H2.5: The relationship between baseline depressive symptoms and post-test physical activity frequency will be significantly attenuated by the simultaneous inclusion of baseline exercise and symptom self-efficacy variables.

H2.6: The relationship between each baseline self-efficacy variable and post-test physical activity will be significantly attenuated by inclusion of baseline outcome expectations.

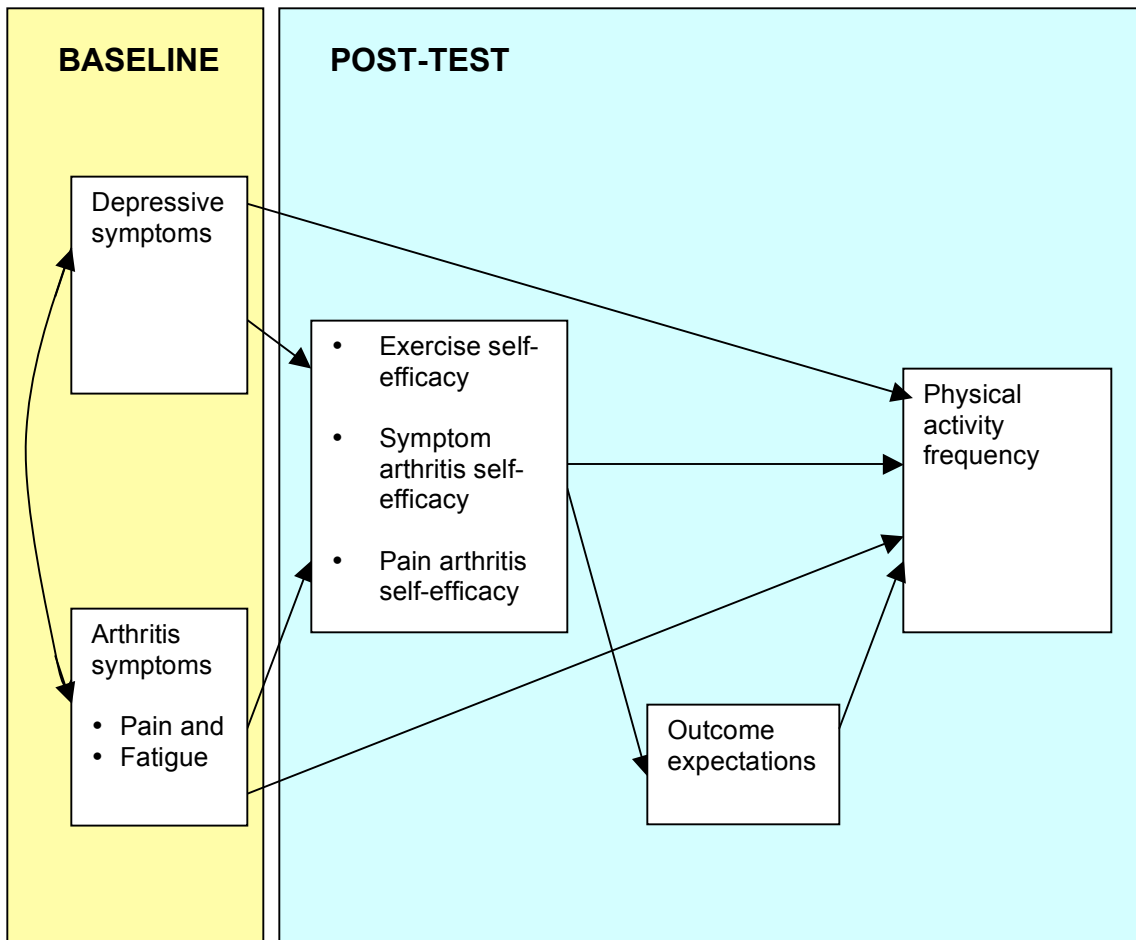
Figure 1. Conceptual model for Aim 2.



Note: This model controls for age, sex, race, education, and number of comorbidities.

Aim 3: To compare the model from Aim 2 with a model of the same relationships, but with self-efficacy and outcome expectations measured instead at post-test.

Figure 2. Alternative conceptual model for Aim 3.



Note: This model controls for age, sex, race, education, and number of comorbidities.

Study design and setting

The parent study consisted of a 20-week randomized controlled trial in which participants (N=339) were randomized into groups that received usual care or the intervention plus usual care (n=172). The control group received the care that they would normally have sought from health care providers or programs. Thus, *usual care* was defined as the care participants received from any health provider or other program. The intervention group was able to continue with their usual care plus the *ALED* intervention. The control group was offered the program after completion by the treatment group. The control group completed questionnaires at the same time as the intervention group and was not followed after the intervention group completed the program. This dissertation focuses on pre and post-test data from the intention-to-treat group, which preserves the original randomization.

Data were collected in 17 urban and rural community-based sites throughout North Carolina, including senior centers, community health centers, or hospital wellness centers.

Sample and recruitment

Participants were recruited with advertisements through a range of channels across North Carolina. Methods included press releases to community newspapers, postings in church bulletins, promotion through a local AM radio channel, speaking at senior and community centers, placing information on local television access channels, and promotional mailings to local rheumatologists,

general practitioners, E-mail listservs, public health departments and the Arthritis Foundation.

Individuals who met the eligibility criteria and attended an information session at either the regional Area Agency on Aging or the intervention site were enrolled. Eligibility criteria were being at least 18 years old, with diagnosed arthritis or self reported joint pain or stiffness, not being too active (engaging in less than 30 minutes, 3 times a week of moderate exercise or not getting heart rate up from daily activity), planning to stay in their community for at least one year, and having a physician release form to participate in physical activity. The intervention participants also expressed a willingness to attend the 20 ALED sessions and complete questionnaires 12 months after the study. Individuals were excluded if they were not proficient in English, had serious medical conditions (history of myocardial infarction, stroke, prescribed beta-blockers, surgery in the previous six months, uncontrolled hypertension, chest pain, diabetes mellitus (uncontrolled insulin-dependent), or severe impairment of mental or physical functioning. Research staff screened potential participants by phone.

Program instructors (N=17) were recruited from the North Carolina Agencies on Aging to represent individuals working in community health programs for the state. Instructors were trained in December 2004 in Chapel Hill, NC by a master trainer from Human Kinetics Active Living Partners according to standardized *ALED* protocol. Training occurred at one time point to ensure standardization of the intervention. All instructors had some experience with

community-based health work but not necessarily among people with arthritis. As part of the training, instructors received teaching materials, a CD-ROM, and completed an online test. They were then certified by Human Kinetics before starting the classes. Research staff provided the instructors with free pamphlets from the Arthritis Foundation and the National Institute of Arthritis and Musculoskeletal Skin Diseases, with information on arthritis-specific topics such as arthritis symptoms and hip replacement. The instructors also received information about the study and completed National Institutes of Health human subjects training. The instructors were able to communicate with each other through a listserv and with the study team by a toll-free phone number. Research staff maintained contact with instructors on a weekly basis to monitor their progress and address any problems.

Data collection

Data collection for the intervention study occurred at three time points: baseline, completion of program (20 weeks) and one year after program completion. For the purposes of this paper, *post-test* will always refer to 20 weeks after the baseline. Both the control and intervention groups completed self-report and performance based assessments at baseline and after program completion. These assessments were administered to treatment and control groups at the class site or the Area Agency on Aging. Baseline data collection occurred at the initial information session, prior to the first program class. Post-test data collection, including both the questionnaire and physical function tests,

were conducted on only one day at each site. Instructors informed the participants of the date when the study team would be at their site to administer the post-test assessments, and the study team then called participants to schedule a time for them to be seen on that day. Participants in the intervention group additionally completed mailed self-report assessments at 12 months **after** program completion. This dissertation used data only from the baseline and immediate post-test time points.

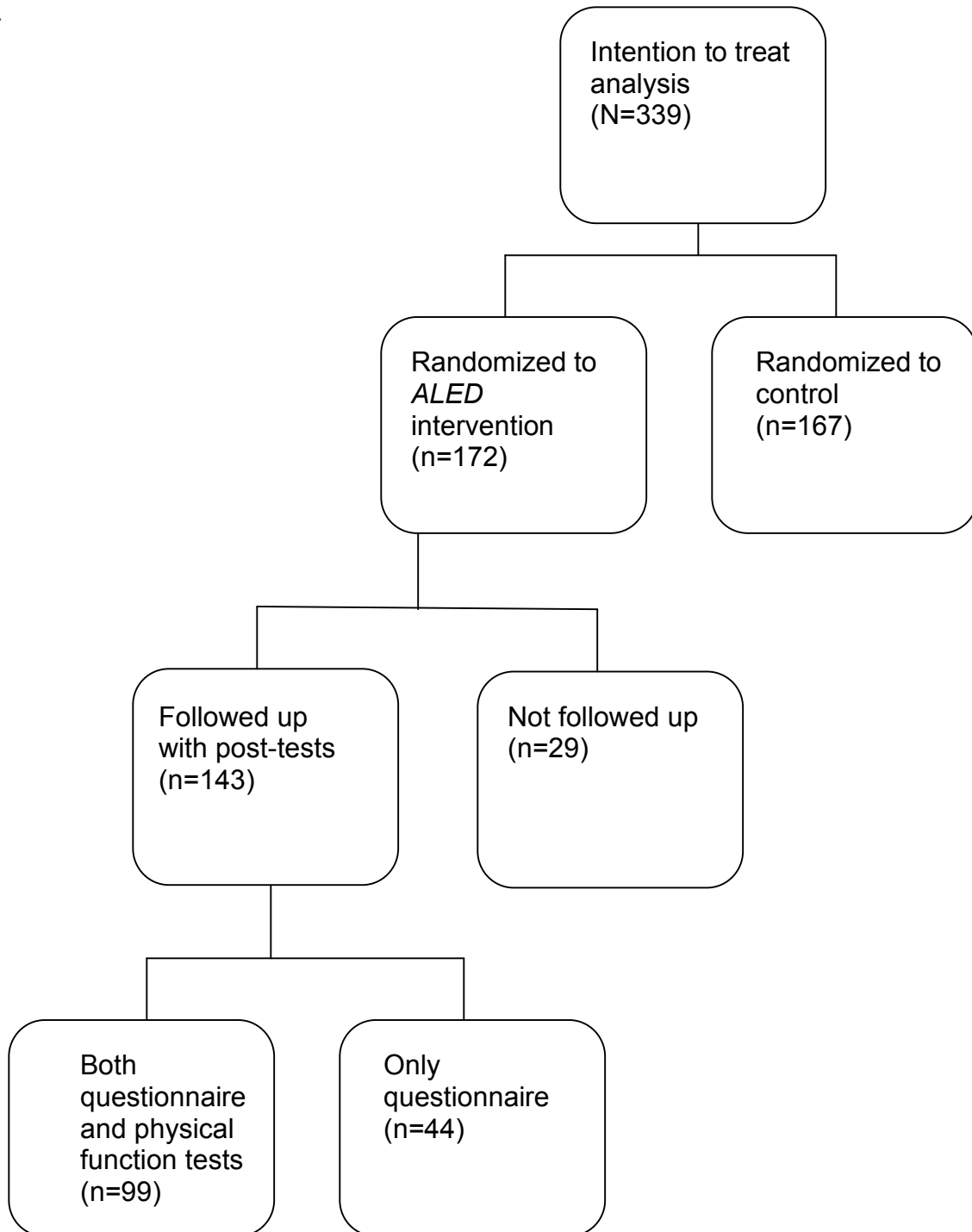
Attrition and missing data

Strategies to retain participants included providing incentives of t-shirts, water bottles, jar openers, and pedometers. Mailings of brochures on arthritis and other related health conditions were provided to maintain involvement of the control group. Project staff contacted instructors weekly to deal with potentially negative situations in a timely manner and prevent similar events from occurring at additional sites.

The participant flow chart (Figure 3) shows the total number of participants in the sample. A total of 172 participants enrolled in the intervention and, of those, 99 (58%) completed both the post-test questionnaire and physical function tests after the end of the intervention and an additional 44 (26%) completed only the post-test questionnaire. Twenty-nine (17%) participants were not followed-up. Some of these participants were not able to complete the post-test physical function measures, because they were out-of-town or had commitments on that day. The study team contacted participants who could not attend on the

designated day and provided them with the post-test questionnaire by mail. If the project staff did not receive a response within a few weeks, they mailed another questionnaire. If there was still no response by the second attempt, the staff contacted the participants by phone. Participants who needed assistance with completing the questionnaire at baseline were contacted by phone to complete the post-test questionnaire. If participants refused to do the full post-test questionnaire, they were asked to complete a brief version, which included questions about health assessment and arthritis symptoms.

Figure 3. Participant flow chart



Measures

All measures, except for the physical function measures, were collected with a paper and pencil questionnaire. Outcomes for this secondary analysis were physical activity level self-reports (frequency and caloric expenditure) and physical function tests (lower-body strength, standing balance and turning ability, and functional mobility).

Dependent variables

Self-reported physical activity frequency and caloric expenditure were measured with the 41-item CHAMPS (Community Healthy Activities Model Program for Seniors) physical activity questionnaire for older adults (Stewart et al., 2001). This questionnaire was designed to ask about meaningful activities for older adults, including moderate intensity exercise. The format was designed to stimulate memory, with specific activities listed along the left side of the page.

Measures of physical activity frequency and estimated caloric expenditure per week were obtained as four scores: 1) frequency for physical activities of moderate intensity; 2) frequency for physical activities of greater intensity (MET (metabolic equivalent) value ≥ 3.0); 3) caloric expenditure for physical activities of moderate intensity; 4) caloric expenditure for physical activities of greater intensity. The MET values, determined using a table developed by Ainsworth et al. (Ainsworth et al., 1993) and adjusted for older adults, were provided with the CHAMPS questionnaire. Frequency was assessed by asking about weekly frequency of participation (“In a typical week during the past 4 weeks, did

you...?” If yes, “how many times a week?”). The frequency measures were continuous and calculated by summing the frequency per week for all categories. Caloric expenditure was also a continuous measure and calculated by multiplying the estimated duration of each activity by the MET value and then summing across all categories. Approximate duration over the week was asked with the question, “How many total hours a week did you usually do it?”, with responses ranging from less than one hour (1) to 9 or more hours (6).

The two-week test-retest reliability reported by Harada et al. (2001) for the CHAMPS moderate-intensity physical activities measure was .76 (for both the Pearson’s and intraclass correlation coefficients) and .62 for all activities (for both the Pearson’s and intraclass correlation coefficients). Construct validity was demonstrated through correlations with activity monitor (.36-.42), performance-based (.46), and self-report measures (.25-.39) (Harada, Chiu, King, & Stewart, 2001).

Lower-body strength, needed for tasks such as climbing stairs, walking, and getting out of a chair, tub or car, was assessed with the timed chair stand test. Increased lower-body strength may also reduce the chance of falling. This test involved recording, to the nearest hundredth of a second, the amount of time that it took for the participant to stand and sit down three times. Gill et al. (1995) showed a relationship between lower-body strength as measured by this test and the increased probability of developing a new disability from the Activities of Daily Living measures at a one-year follow-up (Gill, Williams, & Tinetti, 1995).

Standing balance and turning ability were assessed with the timed 360-degree turn test (Steffen, Hacker, & Mollinger, 2002). This test recorded the time, to the nearest hundredth of a second, that it took for participants to complete a turn to the right and then to the left. This item comes from the Berg Balance Scale (BBS), which consists of 14 items. The BBS has shown intrarater reliability with an ICC of .98 in studies with older adults (Steffen et al., 2002). Criterion-related validity of the BBS has been established with correlations between the BBS scores and other physical function measures among older adults, for example the Timed Up and Go Test which measures the time to stand from a chair, walk 3m and return to the chair ($r=-.76$, $n=31$).

Functional mobility was assessed with the walking speed test at a normal and a fast pace (Steffen et al., 2002). This test measures the speed of one's gait to the nearest hundredth of a second over a 20-foot walkway. Participants were instructed to walk first at a normal, comfortable speed and, then for the fast walking speed, as fast as they safely could. These functional mobility tests evaluated one's ability to increase walking speed above a comfortable pace, reflecting a capacity to adapt to varying environments, such as crossing a street. Gait speed measurements in general, regardless of measurement method, are considered reliable with intrarater, interrater, and test-retest reliability reported as high (ICC=.90-.96, $r=.89-1$) (Steffen et al., 2002). Construct validity has been demonstrated with correlations between measurements of gait speed and measurements of weight shifting tasks (Steffen et al., 2002). Additionally, this measure has shown a sensitivity of 80% and a specificity of 89% in screening

elderly clients' appropriateness for referral for physical therapy (Steffen et al., 2002).

Predictor variables

Depressive and arthritis symptoms

Depression symptoms were defined as the extent of self-reported depressive symptomatology (Radloff, 1977). The Center for Epidemiologic Studies Depression (CES-D) scale has been used to assess presence of depressive symptoms in the general population. Respondents were asked to indicate how often they have felt each of the 20 items during the past week. Sample items are "I was bothered by things that don't usually bother me" and "I did not feel like eating; my appetite was poor." There were four responses per item, ranging from "rarely or none of the time (less than 1 day)" to "all of the time (5-7 days)." The score was used in this study as a continuous measure, the sum of the 20 item weights and ranging from 0 to 60. A score of 16 or more has been considered at risk for depression (Radloff, 1977).

Pain. Magnitude of pain was assessed as a continuous measure with the pain visual analogue scale (VAS). This measure asked participants to mark an X on a 10 cm line to describe the amount of pain they experienced in the past week, with "no pain" on one end of the line and "pain as bad as can be" on the other end. Scores were obtained by measuring in centimeters the distance from "no pain" to the "X" (K. Lorig, 1996).

Fatigue. Magnitude of fatigue was assessed as a continuous measure with the fatigue VAS. Similar to the pain scale, this measure asked participants to mark an X on a 10cm line to describe their level of fatigue within the past week, with “no fatigue” on one end of the line and “extreme fatigue” on the other end (K. Lorig, 1996).

Control beliefs

Helplessness was operationalized as the degree to which participants felt in control over their arthritis. This construct was measured with the five-item subscale of the *Rheumatology Attitudes Index (RAI)* (DeVellis & Callahan, 1993). Responses ranged from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated lower levels of perceived control. This scale was scored using the mean of the five items. DeVellis (1993) found internal consistency reliability to be acceptable, with a Cronbach’s alpha of .70. Validity was demonstrated by significant correlations of self-reported functional status (for example, difficulty with dressing or getting out of bed) and observed activity level (for example, grip strength or walking time) (DeVellis & Callahan, 1993).

Outcome Expectations for Exercise were anticipated outcomes and benefits from exercise. This construct was measured with the Outcome Expectations for Exercise scale, a 9-item scale that asked about exercise expectations specific to older adults (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000). Respondents were asked to state the extent to which they agreed or disagreed with statements related to their personal expectations, such

as, exercise “makes me feel better physically” or “makes my mood better in general.” Responses ranged from 1 (strongly agree) to 5 (strongly disagree). Internal consistency of this scale has been demonstrated with an alpha coefficient of .89. Criterion-related validity has also been shown with significant positive associations of scores with exercise behavior, physical health, and self-efficacy expectations (Resnick et al., 2000).

Self-Efficacy for Exercise, the extent of a person’s confidence in his or her ability to exercise in the face of barriers, was assessed with a 9-item scale (Resnick & Jenkins, 2000). The introduction question used in this study (“How confident are you that you can be physically active if...”) was modified from the original (“How confident are you right now that you could exercise three times per week for 20 minutes if...”). Responses ranged from 0 (not confident) to 10 (very confident). The final score of the scale was the mean of the 9 items. Although the introduction to the items was changed for the main *ALED* study in order to ask about barriers to performing any physical activity rather than barriers to meeting a specified amount of activity, the reliability of the modified version (alpha coefficient of .92) was the same as the original (Resnick & Jenkins, 2000). Construct validity was demonstrated in the original version, with SF-12 physical and mental health subscale scores significantly predicting self-efficacy for exercise scores, in line with the hypothesis that individuals with better health status and mental health are more likely to have stronger self-efficacy for exercise. Criterion validity was established with efficacy expectations significantly predicting exercise activity (Resnick & Jenkins, 2000).

Pain and Symptom Arthritis Self-Efficacy, two subscales of the Perceived Self-Efficacy in People With Arthritis scale, measured people's perceived self-efficacy to deal with the consequences of arthritis (K. Lorig, Chastain, Ung, Shoor, & Holman, 1989). The pain subscale was a 5-item scale measuring people's confidence in performing tasks to manage or cope with pain ("How certain are you that you can decrease your pain quite a bit?" or "How certain are you that you can continue most of your daily activities?"). The other symptom subscale was a 6-item scale measuring people's perceived ability to control their arthritis symptoms other than pain ("How certain are you that you can control your fatigue?" or "How certain are you that you can regulate your activity so as to be active without aggravating your arthritis?") Responses were ordinal, ranging from 1 (very uncertain) to 10 (very certain). The score for each subscale was the mean of the items within each subscale. These measures have demonstrated high reliability, with a Pearson correlation of .87 for the pain self-efficacy subscale and .90 for the symptom self-efficacy subscale. Construct validity has been demonstrated for both subscales with an inverse relationship between pain and self-efficacy and between depression and self-efficacy (K. Lorig et al., 1989).

Demographic and comorbidity variables

Finally, demographic characteristics of age, sex, race, education, and number of comorbid conditions were collected during baseline assessment. These variables were used as control variables, because they are known to relate to physical inactivity among people with arthritis (Fontaine & Haaz, 2006).

Presence of co-morbidity among people with arthritis is extremely high. After adjusting for age, sex, race-ethnicity and education, eighty percent of respondents with self-reported arthritis in a nationally representative household survey reported at least one other physical or mental disorder. Comorbidity was shown to account for more than half of the association between arthritis and days that individuals were unable to work or carry out normal activities (Stang et al., 2006). Assessment and management of arthritis thus needed to be understood and managed within the context of these comorbid conditions.

Analysis strategy

Missing data

Participants in the intervention group who did not complete the post-test questionnaire (n=29) were deleted from analysis under the rationale that additional benefits would not be gained by imputing the outcome variables (Allison, 2001). Analyses were conducted on key variables to determine if there was a difference at baseline between those in the intervention group who completed the post-test questionnaire and those who did not, and no significant differences were found. This sample loss may have resulted in inflated standard errors or compromised analytic power.

Multiple imputation was conducted with SAS v9.1 using the Markov Chain Monte Carlo method to fill in missing predictor variables of the remaining cases (SAS Inc., 2003). The number of missing responses per item varied from 0 to 49.

Analysis for Specific Aim 1

AIM 1: To identify baseline predictors of post-test physical activity and physical function for people who participated in the intervention.

I used multiple linear regression methods to examine predictors of better outcomes (*i.e.*, physical activity level and physical function). I started with a model of the candidate variables and then trimmed to arrive at the most parsimonious model, using investigator controlled block entry analysis (Meyers, Gamst, & Guarino, 2006). The objective of this approach was to explore the unique contribution of each of the following variable sets: arthritis symptoms (pain and fatigue), depressive symptoms (CES-D) and control beliefs (helplessness, arthritis and exercise self-efficacy, and exercise outcome expectations) to variance in physical activity level and physical function after the intervention. The contribution of demographic characteristics (age, race, sex, and education) and comorbidities were examined on their own as a set and used as covariates with the other sets of variables. The relative importance of each of the variable sets was assessed by evaluating the significance of their uniqueness indices (R^2 change), the percentage of variance in a criterion accounted for by given predictors or sets of predictors above and beyond the other variable sets in the model (O'Rourke, Hatcher & Stepanski, 2005). The Schwarz Bayesian Information Criterion (BIC) was used as a model fit index. This criterion is appropriate for selection among models with different numbers of parameters, because it introduces a penalty term for the number of parameters in a model. A smaller BIC indicates a better model fit (Singer & Willett, 2003).

Analysis for Specific Aims 2 and 3

AIM 2: To examine whether baseline self-efficacy and, in turn, outcome expectations mediated relationships between baseline pain, fatigue, and depression and post-test self-reported physical activity frequency.

AIM 3: To compare the model from Aim 2 with a model of the same relationships, but with self-efficacy and outcome expectations measured instead at post-test.

I used mediation techniques to examine whether self-efficacy and outcome expectations affected a relationship between baseline symptoms (of pain, fatigue and depression) and post-test physical activity frequency. Because post-test physical activity frequency was significantly correlated with the objective physical function outcomes (see Table 6) and data were not available for about 50 participants, I did not include physical function in this aim. I conducted multiple mediation analysis to determine whether the different self-efficacy variables simultaneously functioned as mediators (Figure 4). Multiple mediation evaluates how an independent variable affects a dependent variable through more than one intervening variable, or mediator. A multivariate extension of the product-of-coefficients test was used to determine the multiple mediated effect, the amount of attenuation in the relationship between an independent and dependent variable when controlling for the intervening variable (MacKinnon, Krull, & Lockwood, 2000; Preacher & Hayes, 2008). This approach involved multiplying the unstandardized regression coefficient obtained from regressing the mediator on the independent variable (α) with the unstandardized regression coefficient obtained from regressing the outcome on that mediator (β). The indirect effects for each mediator in the model were then summed, $f = \alpha_1\beta_1 + \alpha_2\beta_2 + \alpha_3\beta_3$ (Figure 4) (Preacher & Hayes, 2008). I then used single mediation to

evaluate whether outcome expectations for exercise functioned as a mediator between each self-efficacy variable and physical activity (Figure 5). Covariates used in the mediation analyses were age, sex, race, education, and number of comorbidities.

Figure 4. Multiple mediation model.

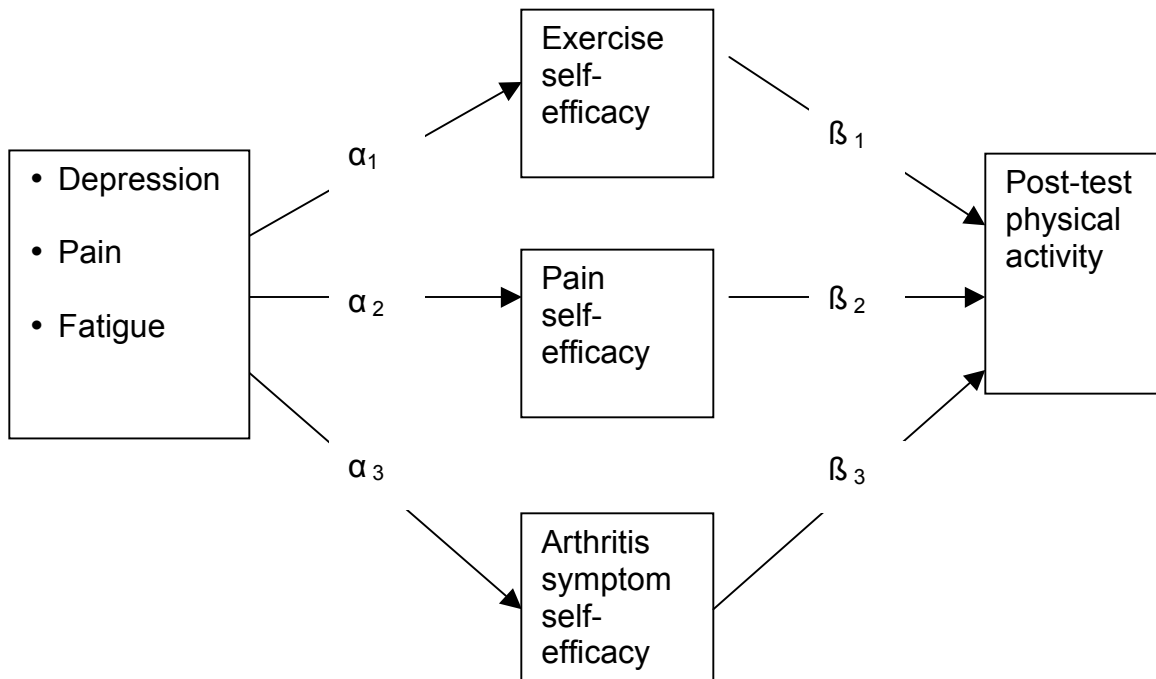
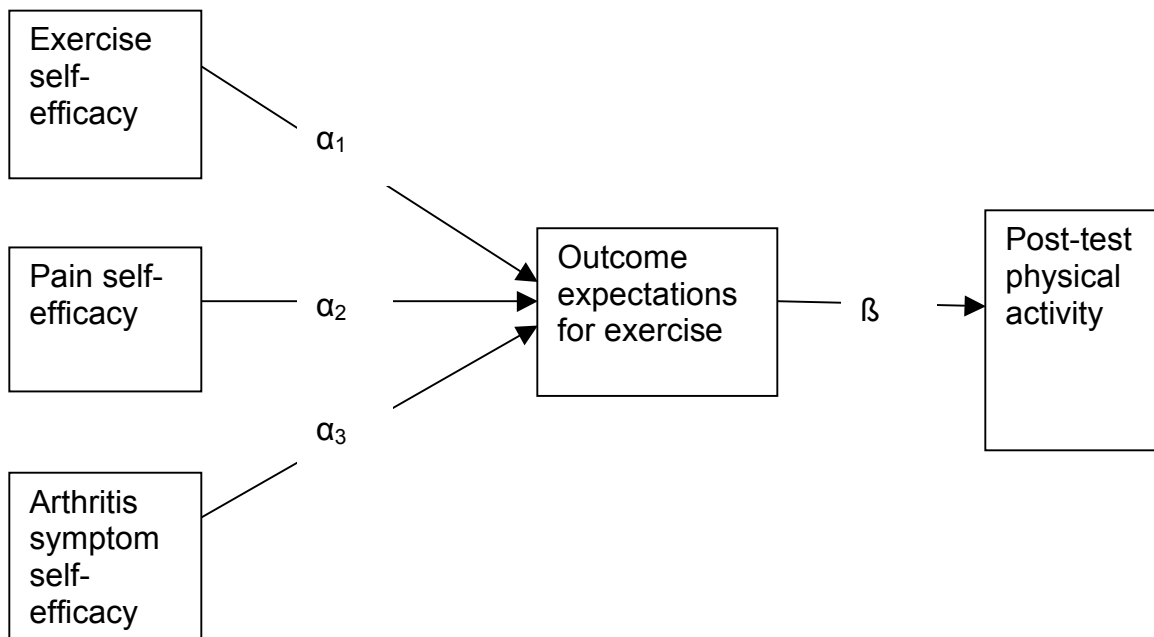


Figure 5. Single mediation model.



The Sobel test was used to determine if the mediated effect was statistically significant from zero, showing no effect. This test involved standardizing the mediated effect by dividing the mediated effect with the standard error of the mediated effect, producing a z score for comparison with a standard normal distribution (D. P. MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). A formula provided by MacKinnon (2000) was used to calculate the standard error of the mediated effect. This analysis was conducted with SAS 9.1.

4. RESULTS

Description of the study sample

The final sample for this dissertation included a total of 143 participants. Demographic characteristics are shown below in Table 2. The mean age was 68 years. The majority of participants were female (86%) and white (75%). Slightly more than half of the sample (55%) had greater than a high school education. Also, more than half of the sample (55%) reported being currently married. Eighteen percent of participants reported working either full or part-time, 16% said that they were not working due to poor health, and 17% reported working as a homemaker. The average time that these participants had arthritis was 11 years. Most (80%) reported at least one comorbid condition, with over 50% having two or more.

Table 2. Demographic characteristics and comorbidities of the *ALED* intervention group (Intention to treat) (N=143)

Variable	%(N)
Mean age (SD)	68 (10.6) (143)
Female	86 (118)
Race	
White	76 (109)
Black	20 (28)
Other	1 (2)
Married	55 (78)
Education > high school	55 (76)
Employment status	
Retired	45 (61)
Working full or part time	18 (24)
Homemaker	17 (23)
Disabled, unemployed or retired due to ill health	16 (22)
Mean years had arthritis (SD)	11.4 (11)(117)
Number of Comorbidities	
0	20 (28)
1	34 (49)
2	25 (35)
3	15 (22)
4	4 (6)
5	1 (2)

The mean scores for baseline and post-test arthritis symptoms, depressive symptoms, and control beliefs for this sample are summarized in Table 3. A paired sample *t*-test was used to determine whether the relationships between the baseline and post-test scores of the independent variables were statistically significant. Mean levels of pain and depressive symptoms decreased between baseline and post-test, and these relationships were statistically significant at $p < .05$. The mean level of fatigue remained about the same between baseline and post-test. Means for all of the control belief variables slightly improved, and, of these, only the tests for outcome expectations and perceived helplessness were statistically significant at $p < .10$.

Table 3. Physical and Depressive Symptoms and Control Belief Variables of ALED Intervention Group

Variables	Baseline		Post-test		<i>p</i>
	N	Mean (SD) Min-Max	N	Mean (SD) (Min-Max)	
Arthritis Symptoms (mm on VAS)					
Pain	135	43.6 (27.8) 0-100	134	38.2 (27.6) 0-100	0.0142
Fatigue	134	41.2 (30.6) 0-100	133	41.1 (30.6) 0-100	0.7991
Depressive Symptoms	138	15.3 (10.3) 0-53	139	13.7 (9.2) 0-56	0.0243
Control Beliefs					
Exercise self-efficacy	141	6.5 (2.1) 1-10	139	6.6 (2.1) 1-10	0.6243
Symptom arthritis self-efficacy	141	7.1 (2.2) 1.1-10	140	7.3 (2.1) 1-10	0.2834
Pain arthritis self efficacy	141	6.6 (2.2) 1-10	139	6.9 (2.1) 1-10	0.1160
Outcome expectations for exercise	139	4.0 (0.7) 1-5	140	4.2 (0.7) 1.4-5	0.0578
Perceived helplessness	140	2.4 (1.0) 1-4.6	139	2.3 (1.0) 1-4.6	0.0792

Note: VAS=Visual Analogue Scale. Higher scores are better for self-efficacy and outcome expectations. Lower scores are better for symptoms and perceived helplessness.

The mean baseline and post-test physical activity level and physical function measures for this sample are shown in Table 4. Physical activity frequency and caloric expenditure increased significantly ($p < .0001$) between baseline and post-test. All of the observed measures of physical function improved; however, only the timed chair stand and normal walking speed tests increased significantly from baseline.

Table 4. Physical Activity and Function Measures of ALED Intervention Group

Variables	Baseline		Post-test		<i>p</i>
	N	Mean (SD) Min-Max	N	Mean (SD) (Min-Max)	
Physical activity level					
Frequency (times/ week)	141	12.4 (9.8) 0-45	139	22.3 (14.2) 0-78	<.0001
Caloric expenditure (MET values/ week)	141	2,312.1(2,420.3) 0-14,690.7	139	3,740.2 (3974.4) 71.4-25,538.7	<.0001
Physical function					
Timed chair stand (sec)	139	12.0 (5.0) 3.0-37.7	94	10.1 (3.4) 4.0-25.2	0.0004
Timed 360 degree turn right (sec)	139	3.8 (1.4) 1.8-11.1	97	3.6 (1.8) 1.8-16.3	0.7220
Timed 360 degree turn left (sec)	139	3.8 (1.4) 1.7-12	97	3.5 (1.6) 1.8-12	0.9652
Normal walking speed (m/sec)	140	1.0 (.24) .3-1.8	99	1.1 (.25) .4-1.8	<.0001
Fast walking speed (m/sec)	140	1.4 (.36) .5-2.7	99	1.5(.35) .5-2.3	0.2088

Note: Post-test physical function measures were collected on fewer than the full sample due to scheduling conflicts with some participants on the day of the post-test data collection. Those who were unavailable to complete the post-test questionnaire and physical function on the day of the site visit were called to complete the questionnaire over the phone. Higher scores are better for physical activity level and walking speed. Lower scores are better for the timed chair stand and the 360 degree turning tests. MET is the Metabolic Equivalent.

Results for Aim 1

To identify baseline predictors of post-test physical activity and physical function for people who participated in the intervention.

Bivariate correlations and multiple linear regressions were used to address Aim one. Pearson's correlations are shown in Tables 5 to 8.

Correlations of demographic characteristics and comorbidities with post-test outcomes are shown in Table 5. Education was significantly correlated with all of the outcome variables. Age and comorbidities exhibited significant moderate correlations with all of the physical function tests, and race had significant moderate correlations with three out of five physical function tests.

Table 6 shows the intercorrelations among the outcome variables. Post-test self-reported physical activity was significantly correlated with all of the post-test physical function measures; however, caloric expenditure exhibited only two out of a possible five significant correlations with the post-test physical function measures.

Tables 7 and 8 show correlations of the predictor variables with each other and with the outcomes. Among the predictor variables, all of the baseline symptoms and beliefs were significantly correlated with each other. However, baseline levels of pain did not significantly correlate with self-efficacy for exercise or with exercise outcome expectations at post-test, and baseline levels of fatigue did not significantly correlate with self-efficacy for exercise at post-test. Baseline depressive symptoms were not significantly correlated with any of the post-test outcomes. Some (5 out of 14) of the baseline pain and fatigue measures correlated significantly with the post-test outcomes. Baseline belief variables, in

general, exhibited moderate to strong correlations with the post-test outcomes, with 41 out of 63 correlations statistically significant.

A principal factor analysis with communalities constrained to unity was conducted among the control belief variables to further explore the conceptual structure of the control beliefs set. The correlations matrix (Table 7) shows the degrees of association among item pairs. The factor analysis indicated that this set reflected one factor, with an eigenvalue of 3.1 out of 5 and accounting for 62% of the total variance. The loadings ranged from -.61 for the RAI scale to .90 for the self-efficacy for exercise scale.

Table 5: Pearson's correlations for demographic characteristics and comorbidities with post-test physical activity and physical function

Variable	Self-reported physical activity frequency	Self-reported caloric expenditure	Chairstand	Turn right	Turn left	Normal walking speed	Fast Walking speed
Age	-.059	-.118	.314**	.257*	.261**	-.273**	-.296**
Sex	.046	-.075	-.068	.022	.029	.063	-.002
Race	.041	.107	.047	.211*	.202*	-.127	-.202*
Education	-.194*	-.177*	.302**	.207*	.240*	-.229*	-.308**
Comorbidities	-.142	-.120	.204*	.244*	.283**	-.294**	-.385***

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

Table 6: Pearson's correlations for post-test physical activity level and physical function

Variable	Self-reported physical activity frequency	Self-reported caloric expenditure	Chairstand	Turn right	Turn left	Normal walking speed
Self-reported caloric expenditure	.707***					
Chairstand	-.384**	-.28*				
Turn right	-.261**	-.161	.695***			
Turn left	-.269**	-.164	.729***	.949***		
Normal walking speed	.380***	.299	-.543***	-.679***	-.703***	
Fast walking speed	.411***	.260*	-.622***	-.689***	-.709***	.825***

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

Table 7. Pearson's correlations for baseline arthritis symptoms, depressive symptoms and control beliefs

Variable	Pain	Fatigue	Depressive symptoms	Helplessness	Exercise self-efficacy	Pain arthritis self-efficacy	Symptom arthritis self-efficacy
Fatigue	.583***						
Depressive symptoms	.349***	.409***					
Helplessness	.482***	.497***	.601***				
Exercise self-efficacy	-.164*	-.327***	-.277**	-.316***			
Pain arthritis self-efficacy	-.289**	-.322***	-.27**	-.396***	.572***		
Symptom arthritis self-efficacy	-.288**	-.388***	-.383***	-.507***	.611***	.833***	
Outcome expectations for exercise	-.130	-.266**	-.262**	-.302***	.545***	.500***	.511***

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

Table 8. Pearson's correlations for baseline arthritis symptoms, depressive symptoms and control beliefs with post-test physical activity and physical function

Variable	Post-test Physical activity frequency	Post-test caloric expenditure	Post-test chairstand	Post-test turn right	Post-test turn left	Post-test gait norm	Post-test gait fast
Baseline pain	-0.015	-.010	.192	.224*	.225*	-.133	-.221*
Baseline fatigue	-0.149	-.024	.128	.180	.186	-.246*	-.140
Baseline depressive symptoms	-0.091	-.109	0.069	-.000	.003	-.026	.080
Baseline helplessness	-.141	-.059	.247*	.260*	.258*	-.287**	-.180
Baseline exercise self-efficacy	.275**	.149	-.204*	-.141	-.141	.138	.182
Baseline pain arthritis self-efficacy	.241**	.149	-.167	-.055	-.055	.164	.190
Baseline symptom arthritis self-efficacy	.292**	.212*	-.246*	-.114	-.114	.201*	.234*
Baseline outcome expectations	.182*	.208*	-.222*	-.147	-.147	.281*	.244*

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

For the first regression, I tested a model with arthritis symptoms, depressive symptoms and control beliefs as candidates, controlling for demographic characteristics and comorbidities. The linear combination of these variables was significantly related to each outcome with the exception of caloric expenditure. The following are the significant multiple squared correlations of this model (the unadjusted squared correlations shown below are also in Tables 9 and 10): $R^2=.19$, adjusted $R^2=.12$, $F(13,4930)=1.97$, $p \leq .05$ for physical activity frequency; $R^2=.43$, adjusted $R^2=.38$, $F(16,1089)=4.46$, $p < .01$ for standing balance; $R^2=.37$, adjusted $R^2=.32$, $F(13,1196)=3.63$, $p < .01$ for turning left ability; $R^2=.36$, adjusted $R^2=.30$, $F(13,1280)=3.44$, $p < .01$ for turning right ability; $R^2=.37$, adjusted $R^2=.32$, $F(13,1260)=3.66$, $p < .0001$ for aerobic endurance, normal walking speed; $R^2=.43$, adjusted $R^2=.38$, $F(13,1072)=4.46$, $p < .0001$ for aerobic endurance, fast walking speed.

I then trimmed the model to determine the unique contribution (R^2 change) of each variable set. These effects are shown in Table 9 for physical activity frequency and caloric expenditure and in Table 10 for physical function. I found that when control beliefs and arthritis symptoms were included in the same model neither provided a statistically significant unique contribution. However, the variance accounted for by control beliefs for the majority of outcomes increased and became statistically significant when I removed symptoms from the equation, indicating overlap between arthritis symptoms and control beliefs in explaining the physical activity and physical function outcomes. The variance accounted for by symptoms also increased when I removed control beliefs, but this change was significant for one less outcome than in the previous analysis. I

determined that a more parsimonious model would include either control beliefs or arthritis symptoms and not both at the same time.

Table 9. Multiple and semi-partial squared correlations obtained in multiple regression analysis predicting self-reported physical activity frequency and caloric expenditure.

	Physical Activity Frequency		Caloric Expenditure	
	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$
Model 1	0.19*		0.15	
Control beliefs		0.07		0.06
Arthritis symptoms		0.01		0.00
Depressive symptoms		0.00		0.01
Model 2	0.17*		0.15	
Control beliefs		0.09*		0.06
Depressive symptoms		0.00		0.01
Model 3	0.12*		0.09	
Arthritis symptoms		0.03		0.00
Depressive symptoms		0.00		0.01
Model 4	0.18*		0.14	
Control beliefs		0.07		0.06
Arthritis symptoms		0.01		0.00
Model 5	0.17**		0.14	
Control beliefs		0.09*		0.06
Model 6	0.11*		0.08	
Arthritis symptoms		0.04		0.01
Model 7	0.09		0.09	
Depressive symptoms		0.01		0.01

Note: All models included demographic characteristics (age, sex, race, education) and co-morbidity. Control beliefs were self-efficacy for exercise, self-efficacy for managing arthritis pain and symptoms, outcome expectations for exercise, and helplessness. Arthritis symptoms were pain and fatigue. Depressive symptoms were from the 20-item CES-D scale. *** $p \leq .0001$, ** $p \leq .01$, * $p \leq .05$

Table 10. Multiple and semi-partial squared correlations obtained in multiple regression analysis predicting physical function.

	Standing		Turn Left		Turn Right		Normal Walk		Fast Walk	
	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$
Model 1	0.43***		0.37**		0.36***		0.37***		0.43***	
Control beliefs		0.08		0.09		0.09		0.08		0.07
Arthritis symptoms		0.03		0.02		0.02		0.04		0.02
Depressive symptoms		0.00		0.02		0.02		0.02		0.04*
Model 2	0.40**		0.36***		0.34***		0.33***		0.42***	
Control beliefs		0.11*		0.11*		0.11*		0.10*		0.09*
Depressive symptoms		0.00		0.02		0.02		0.01		0.03*
Model 3	0.35***		0.29***		0.27***		0.30***		0.36***	
Arthritis symptoms		0.07*		0.04		0.04		0.06*		0.04
Depressive symptoms		0.01		0.00		0.00		0.00		0.02
Model 4	0.43***		0.35***		0.33***		0.36***		0.39***	
Control beliefs		0.08		0.07		0.07		0.06		0.05
Arthritis symptoms		0.03		0.01		0.01		0.04		0.01

Note: All models included demographic characteristics (age, sex, race, education) and co-morbidity. Control beliefs were self-efficacy for exercise, self-efficacy for managing arthritis pain and symptoms, outcome expectations for exercise, and helplessness. Arthritis symptoms were pain and fatigue. Depressive symptoms were from the 20-item CES-D scale. *** $p \leq .0001$, ** $p \leq .01$, * $p \leq .05$

Table 10. (continued)

	Standing		Turn Left		Turn Right		Normal Walk		Fast Walk	
	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$	R^2	$R^2 \Delta$
Model 5	0.40***		0.34***		0.32***		0.32***		0.38***	
Control beliefs		0.15**		0.10*		0.10*		0.09		0.06
Model 6	0.35***		0.28***		0.26***		0.29***		0.34***	
Arthritis symptoms		0.09**		0.04*		0.04		0.06*		0.03
Model 7	0.29***		0.25***		0.23**		0.24***		0.32***	
Depressive symptoms		0.03*		0.00		0.00		0.00		0.00

Note: All models included demographic characteristics (age, sex, race, education) and co-morbidity. Control beliefs were self-efficacy for exercise, self-efficacy for managing arthritis pain and symptoms, outcome expectations for exercise, and helplessness. Arthritis symptoms were pain and fatigue. Depressive symptoms were from the 20-item CES-D scale. *** $p \leq .0001$, ** $p \leq .01$, * $p \leq .05$

I used the Bayesian Information Criterion (BIC), which introduces a penalty for the number of parameters in a model, as another indicator of model fit (see Table 11 below). Better fitting models are those with smaller BIC values, *i.e.*, smaller positive or more negative values. I excluded caloric expenditure as an outcome from Table 11, because it did not show significant correlation in the prior analysis.

Smaller BIC values were associated with models that included control beliefs, confirming that control beliefs were important for predicting the physical activity and function outcomes. Additionally, the BIC indicated that control beliefs alone provided a better fit than arthritis symptoms or a combination of arthritis symptoms and control beliefs for predicting physical activity frequency and the majority of the physical function tests. Conversely, larger BIC values were associated with depressive symptoms, verifying that depressive symptoms should not be included in the best fitting model.

In sum, I determined that the most parsimonious model for predicting physical activity frequency and physical function was one that included control beliefs and the demographic and comorbidity covariates. Including arthritis symptoms in the model did not appear to explain variance in the outcomes above and beyond control beliefs. Furthermore, removing arthritis symptoms from the model seemed to strengthen the contribution of control beliefs. These results suggest that arthritis symptoms overlap with control beliefs in explaining variance in physical activity outcomes, and that these variables do not aid prediction of physical activity for intervention participants.

Table 11. Comparison of model fit by outcome.

Model	Bayesian Information Criterion (BIC)					
	Physical activity frequency	Standing balance	Turning Left ability	Turning right ability	Normal walking speed	Fast walking speed
Model 1: Control beliefs, arthritis symptoms, depressive symptoms	909.5	410.5	116.1	174.2	-516.6	-404.2
Model 2: Control beliefs and depressive symptoms	907.9	414.7	115.8	173.7	-510.7	-403.8
Model 3: Arthritis and depressive symptoms	911.9	414.7	127.3	185.4	-508.4	-395.1
Model 4: Control beliefs and arthritis symptoms	907.5	409.0	119.6	177.6	-514.6	-395.4
Model 5: Control beliefs	906.0	412.9	118.1	175.9	-509.7	-396.6
Model 6: Arthritis symptoms	910.5	420.7	125.8	183.8	-509.9	-393.2
Model 7: Depressive symptoms	913.6	433.3	132.5	190.2	-498.8	-389.9

Standardized regression coefficients (β) for the final model predicting self-reported physical activity and function are displayed in Tables 12 and 13. Baseline education was a significant predictor for post-test physical activity frequency ($\beta=-.20$, $p\leq.05$) and lower body strength (chair stand test) ($\beta=.28$, $p\leq.05$), controlling for control beliefs, other demographic characteristics and comorbidities. Although education was not a significant predictor for the turning or walking tests in the regression model, it had significantly correlated with these outcomes in bivariate analyses (Table 5). Age and race significantly predicted the majority of the physical function outcomes and comorbidities significantly predicted the walking tests. Helplessness was significantly related to the physical function tests in the expected direction, in which more helplessness predicted more time to complete the chairstand and turning tests and less distance covered in the normal speed walking test.

Table 12. Multiple regression analysis of self-reported post-test physical activity

Variable	Self-reported post-test physical activity frequency β	Self-reported post-test caloric expenditure β
Demographic characteristics		
Sex	.07	-.06
Age	-.06	-.11
Race	0.0	.10
Education	-.20*	-.14
Comorbidities	-.06	-.08
Control beliefs		
Exercise self-efficacy	.19	.01
Arthritis symptom self-efficacy	.26	.26
Arthritis pain self-efficacy	-.08	-.13
Helplessness	.03	.16
Outcome expectations for exercise	-.05	.13

Sex was coded as: 0, male; 1, female; Race was coded as: 0, white; 1, non-white; Education was coded as: 0, >HS education; 1, <HS education

* $p < 0.05$

Table 13. Multiple regression analysis of post-test physical function tests

	Post-test chairstand	Post-test turn right	Post-test turn left	Post-test gait norm	Post-test gait fast
Variable	β	β	β	β	β
Demographic characteristics					
Sex	-.03	.01	.02	.07	.02
Age	.33**	.33**	.32**	-.32**	-.31**
Race	.20**	.25*	.23*	-.18	-.21*
Education	.28**	.10	.13	-.09	-.16
Comorbidities	-.02	.13	.16	-.18*	-.27**
Control beliefs					
Exercise self-efficacy	-.10	-.11	-.12	-.06	-.01
Arthritis symptom self-efficacy	-.19	.00	-.04	-.01	.14
Arthritis pain self-efficacy	.20	.18	.21	-.07	-.08
Helplessness	.28**	.31*	.29**	-.22*	-.05
Outcome expectations for exercise	-.07	-.03	-.06	.21*	.17

Sex was coded as: 0, male; 1, female; Race was coded as: 0, white; 1, non-white; Education was coded as: 0, >HS education; 1, <HS education

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

Results for Aim 2

To examine whether baseline self-efficacy and, in turn, outcome expectations mediated relationships between baseline pain, fatigue, and depression and post-test self-reported physical activity frequency.

The purpose of this aim was to examine a potential indirect relation of baseline pain, fatigue, and depression to post-test physical activity frequency (See Figure 1). As hypothesized (H2.1), depressive and arthritis symptoms were positively correlated ($r=.35$, $p<.0001$ for correlation between depressive symptoms and pain and $r=.41$, $p<.0001$ for correlation between depressive symptoms and fatigue). It was also hypothesized that there would be significant inverse relationships between these candidate predictors and post-test physical activity (H2.2) and that these relationships would be significantly attenuated with the inclusion of first the baseline self-efficacy variable set (H2.3-2.5) and secondly outcome expectations (H2.6). Hypothesis 2.2 was partially supported, with a significant inverse relationship found only between baseline fatigue and post-test physical activity frequency ($\beta=-.18$, $p\leq.05$). Although there were no significant relationships between the other candidate predictors and post-test physical activity, it was reasonable to proceed with investigating potential indirect effects. McKinnon notes that multiple mediation models are likely to have inconsistent effects, *i.e.*, a set of mediators may include both positive and negative relationships, thus potentially precluding a significant total effect (MacKinnon, 2008).

Table 14 presents the results of this analysis. The paths α and β for this model are depicted in Figure 4.

Table 14. Point estimates and potential indirect effects obtained in multiple regression analysis predicting physical activity frequency: baseline measures of self-efficacy variables

Predictor	Potential mediator	Estimate α (SE)	Estimate β (SE)	Estimate $\alpha\beta$ (SE)
Pain	Pain arthritis self-efficacy	-.28** (.08)	-.08 (.15)	.02 (.04)
	Symptom arthritis self-efficacy	-.29** (.08)	.24 (.15)	-.07 (.05)
	Exercise self-efficacy	-.16 (.08)	.18 (.11)	-.03 (.02)
	TOTAL			-.08* (.05)
Fatigue	Pain arthritis self-efficacy	-.32*** (.08)	-.08 (.15)	.03 (.05)
	Symptom arthritis self-efficacy	-.39*** (.08)	.21 (.15)	-.09 (.06)
	Exercise self-efficacy	-.32*** (.08)	.17 (.11)	-.05 (.04)
	TOTAL			-.11* (.04)
Depression	Pain arthritis self-efficacy	-.21** (.01)	-.08 (.16)	.02 (.04)
	Symptom arthritis self-efficacy	-.36*** (.01)	.23 (.16)	-.08 (.06)
	Exercise self-efficacy	-.21** (.01)	.18 (.11)	-.04 (.03)
	TOTAL			-.10* (.04)

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

The magnitude of attenuation, or the mediated effect ($\alpha\beta$), in the multiple mediation model was significant at $p \leq .05$ for all predictors. Examination of specific variables revealed that no single variable had a significant indirect effect within the context of this multiple mediation model. However, it is important to note that the specific indirect effects may be insignificant due to correlation between the mediators within the set. Thus, specific mediators may not appear to function as such (Preacher & Hayes, 2008).

Finally, baseline outcome expectations were entered to determine whether they mediated the relationship between each self-efficacy variable and post-test physical activity (Figure 5). Inclusion of baseline outcome expectations did not result in a significant mediated effect.

Results for Aim 3

To compare the model from Aim 2 with a model of the same relationships, but with self-efficacy and outcome expectations instead measured at post-test.

Table 15 presents results of the mediation analysis using post-test self-efficacy variables (See Figure 4 for the conceptual model). The magnitude of attenuation was significant for all predictors as with the baseline multiple mediation models from Aim 2. The only individual variable that had a statistically significant mediated effect in this model was self-efficacy for exercise, controlling for the other self-efficacy variables and depression.

The relationship between each post-test self-efficacy variable and physical activity was not significantly attenuated with the inclusion of post-test outcome

expectations for exercise. This was the same finding as with the model using variables measured at baseline.

Finally, I decided to test a model in which post-test outcome expectations mediated between each baseline self-efficacy variable and post-test physical activity. This model was not included in my aims, but I wanted to see if there was a relationship between baseline self-efficacy and post-test outcome expectations in predicting physical activity frequency. This model did result in a significant mediated effect between self-efficacy for exercise and physical activity ($\alpha\beta = .08$, $p \leq .05$).

Table 15. Point estimates and potential indirect effects obtained in multiple regression analysis predicting physical activity frequency: post-test measures of self-efficacy variables

Predictor	Potential mediator	Estimate α (SE)	Estimate β (SE)	Estimate $\alpha\beta$ (SE)
Pain	Pain arthritis self-efficacy	-.37*** (.08)	.17 (.14)	-.06 (.06)
	Symptom arthritis self-efficacy	-.38*** (.09)	.04 (.14)	-.02 (.05)
	Self-efficacy for exercise	-.07 (.09)	.33** (.09)	-.02 (.03)
	TOTAL			-.10* (.05)
Fatigue	Pain arthritis self-efficacy	-.38*** (.09)	.15 (.14)	-.06 (.06)
	Symptom arthritis self-efficacy	-.40*** (.08)	.01 (.14)	-.00 (.06)
	Self-efficacy for exercise	-.20* (.09)	.34** (.09)	-.07 (.04)
	TOTAL			-.13** (.05)
Depression	Pain arthritis self-efficacy	-.21* (.08)	.16 (.14)	-.03 (.03)
	Symptom arthritis self-efficacy	-.30** (.08)	.03 (.15)	-.01 (.04)
	Self-efficacy for exercise	-.25** (.09)	.34** (.09)	-.08* (.04)
	TOTAL			-.13* (.04)

*** $p \leq .0001$; ** $p \leq .01$; * $p \leq .05$

5. DISCUSSION

Summary

This study showed that control beliefs were important predictors of post-intervention physical activity and physical function for *ALED* participants with arthritis. Control beliefs emerged as important predictors in the exploratory analysis (Aim 1) and the theoretical models (Aims 2 and 3). Education has a positive association with physical activity in the general literature, and the findings from this study replicated that relationship with self-reported physical activity frequency and observed physical function among program participants. Sex and race were also significantly related to the majority of the physical function outcomes. These variables have been well established as predictors of physical activity among people with arthritis and as such were used as control variables (Fontaine & Haaz, 2006). Although depression has been reported to be a barrier to physical activity in cross-sectional studies, baseline depressive symptoms did not predict post-test physical activity among the *ALED* participants.

The multiple mediation analysis in Aim 2 provided more information on how self-efficacy variables influenced physical activity at the beginning and end of the intervention and in concert with outcome expectations. Self-efficacy for arthritis pain, symptom coping, and exercise as a set significantly attenuated the

relationships between symptoms at the beginning of the intervention and physical activity at the end, indicating an intervening role for these self-efficacy variables. These effects were evident when self-efficacy was measured both at baseline and post-test, showing a significant role for self-efficacy both before and immediately after the intervention. The relationship between baseline self-efficacy and post-intervention physical activity was additionally attenuated by post-test outcome expectations. This result indicates that participants' post-test perceptions may reflect beliefs about physical activity that are independent of their initial self-efficacy, for example the expectation that physical activity can help people feel better regardless of one's own skill level.

Control beliefs related to physical activity

The control belief variables reflected participants' perceptions about their ability to have an impact on their health and symptoms. This variable set consisted of beliefs about their ability to exercise (self-efficacy for exercise) and about the effect of exercise on their physical and mental health (outcome expectations). It also included beliefs about whether their symptom management was beyond their control (helplessness) and whether they could manage their symptoms in the face of barriers (pain and symptom arthritis self-efficacy).

The significant contribution of control beliefs toward explaining physical activity in this sample is consistent with other studies of people with arthritis (Der Ananian et al., 2008; S. Wilcox et al., 2005). Der Ananian et al. (2008) found that exercisers with arthritis reported greater self-efficacy than non-exercisers.

Wilcox et al. (2005) found in a review of articles on exercise and arthritis that expected benefits of exercise consistently correlated with higher physical activity levels. Some of the expected benefits mentioned in qualitative studies as motivators for engaging in physical activity included positive physical outcomes and improved symptoms (Wilcox et al., 2005). This dissertation adds to the literature on control beliefs and physical activity by examining how control beliefs relevant to both arthritis symptoms and physical activity relate to physical activity for people with arthritis in a lifestyle exercise program.

Focusing on how symptom and exercise control beliefs simultaneously relate to physical activity outcomes has practical relevance. Current practice in structured exercise intervention for older adults addresses physical and psychological influences on exercise behavior through group-mediated behavioral counseling, which aims to facilitate exercise maintenance in the face of limitations through motivation and self-regulation (Rejeski & Brawley, 2006). The Arthritis Self-Management Course is also built on this interface between self-efficacy and symptom management, providing information about managing disability from within the context of pain management (Lorig & Holman, 2003). This dissertation additionally supports teaching both arthritis and exercise specific cognitive behavioral strategies to participants with arthritis in lifestyle physical activity promotion.

Analyses that explore how multiple types of self-efficacy mediate between symptoms and physical activity are not common. Self-efficacy is generally conceptualized and measured specific to a single domain or behavior. The

strength of the relationships between pain, fatigue, depression and physical activity was significantly reduced when the self-efficacy variables were added, suggesting a potential intervening role for these three types of self-efficacy. This effect occurred with self-efficacy measured both at the beginning and at the end of the intervention. This temporal aspect is supported by the research of Lorig and Holman (2003), who found that baseline and changed arthritis self-efficacy were both associated with future health status. Furthermore, even though the focus of *ALED* was on building self-efficacy for exercise and not on symptom management, there was an increase by the end of the intervention in both symptom and pain self-efficacy. Participants reported in a prior qualitative analysis from this sample that the intervention helped them deal with and push beyond their pain to exercise (Callahan et al., 2007). These findings suggest that even though pain is a reported barrier for doing physical activity, an integrated approach might be the most effective, in which analgesic pain management is combined with cognitive-behavioral techniques for reducing pain catastrophizing and enhancing self-efficacy (Lin, 2008).

Because the control belief variables selected for this analysis are interdependent, future research should explore how they interact to predict physical activity. Examination of interactions could test whether the relationship between self-efficacy for exercise and physical activity frequency varies by expected outcomes. As Bandura (1997) suggests, high self-efficacy could be associated with “productive engagement” or “aspiration” and, in this case, more physical activity for people with high outcome expectations. In contrast, those with low

expectations would be less likely to follow the program, despite having high self-efficacy. According to Bandura, it is also possible that a relationship between outcome expectations and physical activity could vary by self-efficacy, such that the lower the self-efficacy level, the less active involvement of the participant. This relationship would likely be reflected in a weaker association between outcome expectations and physical activity for those with low self-efficacy. It would also be interesting to test if the relationship between outcome expectations for exercise and physical activity frequency varies by pain or symptom self-efficacy.

Post-test outcome expectations

Outcome expectations for exercise, measured at the end of the intervention, additionally contributed to the relationship between baseline self-efficacy for exercise and physical activity level. Kirsch and Bandura assert that outcome expectations can influence behavior beyond self-efficacy when there are factors involved other than one's abilities (Maddux, 1995b). Thus, in addition to having confidence to exercise in the face of potential barriers, motivation to obtain benefits of exercise, such as feeling better physically or mentally, may have been a reason for increased physical activity levels. Wilcox et al. (2006) found that among a sample of older women initial outcome expectations were predictive of later physical activity behavior when combined with an interim measure of their perceptions of change, labeled "outcome realizations" (Wilcox, Castro, & King, 2006). Individuals with low initial expectations and high outcome

realizations were pleasantly surprised with their ability to do physical activity and thus motivated to continue. She suggested that outcome expectations are best conceptualized as a mediator, which may be affected by an intervention and, in this way, bring about change in the outcome (Wilcox et al., 2006). This relationship is likely to be stronger when people are efficacious compared to when they are not.

It is notable that this effect was not found for outcome expectations measured at the start of the intervention. However, it is possible that outcome expectations could have been influenced by the intervention after the start of the intervention. Future research should include more frequent assessment of outcome expectations to more precisely track the point at which outcome expectations may have changed.

Education and physical activity

Education predicted physical activity frequency and the chair stand test. Although education was not a significant predictor for the turning or walking tests when included in the regression models, it was significantly correlated with these outcomes in bivariate analyses.

These findings are consistent with the literature on physical activity among adults in general and adults with arthritis (Centers for Disease Control and Prevention (CDC), 2008; Fontaine & Haaz, 2006; Shih, Hootman, Kruger et al., 2006) and add to the literature by demonstrating this relationship within a lifestyle physical activity intervention. Adults with higher education levels were more

likely to meet the *2008 Physical Activity Guidelines for Americans* and the more conservative *Healthy People 2010* recommendations for moderate intensity physical activity, both published by the U.S. Department of Health and Human Services. (Centers for Disease Control and Prevention (CDC), 2008). Education level was also a significant predictor for adults with arthritis using 2002 National Health Information Survey data: those with a high school education or less were 70% more likely to be inactive than those with at least some college education (Shih, Hootman, Kruger et al., 2006). And education was positively related to physical activity in the dissemination study of *ALED* (Wilcox et al., 2009). In that study, participants with higher education levels at pretest were more likely to meet physical activity recommendations at post-test. However, no differences across education levels were found in the original randomized trial, *Project Active*, although participants in that sample were highly educated (Mean=16years) (Dunn et al., 1999). The findings from this dissertation research corroborate the *ALED* dissemination findings with a sample that has more participants who have not completed high school.

Education level has been associated with health literacy, defined as the ability to obtain, process, and understand health information in order to make health decisions (U.S. Department of Health and Human Services, 2000). Reading, writing, oral presentation, and aural comprehension skills are all important aspects of health literacy and the *ALED* program components. Thus, participants with more education may have benefited more from the homework assignments and group discussions. Furthermore, participants with higher

literacy may have been more able to implement the strategies learned in the sessions and communicate problems in the group discussions (Villaire & Mayer, 2007). This discrepancy is particularly true within the context of arthritis self-management, which is complex and requires a relatively high level of literacy skill (Rudd, Rosenfeld, & Gall, 2007). A potential strategy for tailoring interventions to meet needs of individuals with lower health literacy levels includes reworking the assignments to a different grade level.

Higher levels of education have been associated with higher levels of personal control throughout the life course, with the gap between different education levels widening as people age (Mirowsky & Ross, 2007). This relationship is partly attributed to having experienced the formal education process, which involves tackling and mastering complex challenges. Pursuing and completing a degree may help people develop effective problem solving skills and confidence that their actions can lead to outcomes. To get through school, one must generally display persistence as well as ability, two characteristics fundamental to problem solving. By developing skills related to proactively seeking and interpreting information, education increases control over situations that may not be obvious or explicit, such as unanticipated occurrences. The education process may help individuals gain confidence that comes from knowing that they have the agency to deal with problems.

Relevance of depressive symptoms

The lack of a significant relationship between baseline depression and post-intervention physical activity suggests that level of depression symptoms may not be directly predictive of program success. It is possible that participants were motivated to change from the start and that an effect of depression on physical activity would have been found at a different time point. Conceptualizing behavior change in terms of stages in this analysis might have elicited different results. For example, the Health Action Planning Approach model separates behavior change into planning, action and maintenance phase with self-efficacy playing a crucial role at all stages (Schwarzer, 2008). Using this framework, it is conceivable that depressive symptoms in this intervention group might have been predictive of behavior change at the planning phase but not the action phase.

The mean baseline depression level in this sample did decrease by the end of the intervention, although the difference was not statistically significant. Wilcox (2006) found in the dissemination of *ALED* that depressive symptoms also decreased among their intervention participants. *ALED*'s focus on setting small, manageable goals and following one's own pace may have been particularly effective for participants with higher levels of depressive symptoms, for inability to reach goals has been found to predict depression at a later time (Maes & Karoly, 2005). Assistance with goal pursuit through group meetings and homework assignments may have prevented depressive symptoms at the baseline from influencing physical activity behavior down the road. The nature of

the goals pursued in the intervention may have also been appropriate for mitigating depressive symptoms, for intrinsic goals, such as obtaining a feeling of competence for overcoming exercise barriers, have been positively associated with mental well-being compared with externally focused goals, such as pleasing others (Deci & Ryan, 2000). The social aspect of the group meetings also may have attenuated the influence of depressive symptoms on physical activity. Social and leisure limitations have been associated with increased odds of having serious psychological distress (Shih et al., 2006). Qualitative interviews with *ALED* completers suggest that social support was a major part of the program's success from their perspective (Callahan et al., 2007).

The relationship between depressive symptoms and physical activity may have been confounded by arthritis symptoms, such as pain or fatigue, even when they were included as covariates. Depression has a known relationship with arthritis symptoms (Rosemann et al., 2007). In the present study, depressive symptoms had correlations of .35-.41 with arthritis symptoms. Responses to questions about depressive symptoms could have reflected experiences with physical aspects of arthritis. (Blalock et al., 1989) suggested that four items on the CES-D may be influenced by the experience of arthritis symptoms rather than depression, potentially resulting in inflated scores. In a meta-analysis of depression in rheumatoid arthritis, Dickens et al. (2002) also found that variability in effect size for depression depended on the measure used and the type of arthritis, with the CES-D more likely to measure higher levels. Using a clinical diagnosis, with DSM criteria, to measure depression could minimize this bias.

Limitations and strengths

The analysis of variables as sets contributed both limitations and strengths. The variables were organized into blocks based on theoretical and practical relevance. Correlations between predictors within each set influenced the beta weights and thus placed limits on evaluating the individual independent variables. However, analyzing the variables as sets allowed exploration of the influence of content areas, such as control beliefs or arthritis symptoms.

Mediation techniques enabled inference of *how* or *why* one variable influenced another. This knowledge can help identify mechanisms to target in an intervention to most effectively influence outcomes (Frazier, Tix, & Barron, 2004). Because this analysis included only two time points, a mediator variable was assessed at either the same time as the independent or dependent variables. This cross-sectional analysis limited inferences about causal relationships. However, there was a theoretical basis for assuming that the candidate predictor variables preceded the potential mediator and that the potential mediator preceded the dependent variable. Furthermore, comparing models with mediators measured at baseline versus post-test provided more information about whether it mattered that the potential mediators were measured more proximally or distally to the outcome.

By conducting mediation analysis, I was able to gain more information about relationships between the variables that may or may not be causal and that could be tested in future studies (Chmura Kraemer et al., 2008). One factor that would be useful to include in a causal pathway is intervention dose. However,

everyone in this sample attended the baseline information session and received the ALED textbook. Thus, one limitation of this data was that there was no way to tell what people did in terms of self-study.

The physical activity outcome was based on self-report, and although self-reported behavior has been shown to be a valid indicator of health behavior (Lucas & Baird, 2006) there is the possibility of recall bias. The CHAMPS questionnaire, though, was designed specifically to facilitate recall by older adults, with preformatted categories of activities and duration (Stewart et al., 2001). Additionally, physical function measures were analyzed, and there was significant correlation between post-test self-reported physical activity and all of the post-test physical function measures.

I did not control for baseline physical activity. The parent study showed that the intervention group increased overall in physical activity but an evaluation of intervention effects was not the focus of my study. Had I focused on factors that influenced an increase in physical activity, I would have controlled for baseline physical activity. Instead, I was interested in associations among theoretically relevant baseline characteristics and physical activity level in *ALED* participants at the end of the intervention. Furthermore, I determined that baseline physical activity was conceptually relevant to my research questions. It is possible that a positive feedback loop exists in which prior physical activity reduces arthritis and depressive symptoms and strengthens control beliefs, and these symptoms and beliefs, in turn, strengthen physical activity (Harris, Cronkite & Moos, 2006). Not controlling for baseline physical activity raises the issue that

this variable might explain the relationship between baseline characteristics and post-test physical activity. While that issue was not germane to the goals of this research, I plan to explore the presence of this type of feedback loop in future research by controlling for baseline physical activity levels. For this dissertation, controlling for baseline physical activity would have been inconsistent with the focus of my research questions.

6. CONCLUSION

Findings from this dissertation research indicate that lifestyle physical activity interventions for people with arthritis might be made more effective with greater attention given to cognitive behavioral techniques for managing symptoms such as chronic pain. I found in the first aim that symptoms and control beliefs appeared to overlap in explaining physical activity and physical function outcomes. In the second aim, which tested theoretical relationships between these variables, I found that control beliefs significantly mediated the relationships between baseline symptoms and post-test physical activity frequency, and this mediation was evident both at the beginning and end of the intervention.

Personal control forms the core of effective lifestyle interventions, in which the individual self-selects activities, personal goals, and a pace (Dunn, Andersen, & Jakicic, 1998). Best practices for physical activity promotion among older adults, as determined by a national coalition led by the American College of Sports Medicine, include allowing participants to choose their activities (Cress et al., 2005; Stewart et al., 2001). Providing choices enhances self-efficacy, because a self-selected activity is more likely to be one that fits a person's preferences and capabilities. Incorporating these elements of personal control into physical activity interventions is especially important for older adults, because lifestyle changes as a result of aging are often associated with a loss of

perceived control. One way that older adults may maintain a sense of control in the face of life changes is to frame their health behavior goals in terms of aspects of successful aging that they personally value. For example, a strength training program may be regarded as successful for one individual if he or she is able to meet a desired goal of playing ball with a grandchild (Marquez et al., 2009). Definition of success may vary from individual to individual. What is essential is that individuals have the power to choose goals that lead to realistic and valued outcomes. The public health benefit of this approach is that individuals are more likely to maintain regular physical activity over the long term (Cress et al., 2005).

This study adds to the literature on physical activity and arthritis by looking at a joint contribution of arthritis symptom and exercise control beliefs to physical activity within lifestyle intervention. This has practical implications, because it captures a larger part of the context related to better outcomes for people with arthritis within this type of program. This domain reflects beliefs about exercise within the context of one's experience with their symptoms and their ability to manage them.

Testing a theoretical model sheds light on how symptoms and belief variables function within a temporal order. I found that control beliefs mediated a relationship between baseline symptoms and post-test physical activity. This effect was the same regardless of whether the control beliefs were from the beginning or the end of the intervention. These findings suggest that the control beliefs that people bring to a program are important for explaining post-test outcomes, and that targeting both types of self-efficacy may mitigate a

relationship between symptoms and physical activity. The theoretical model also showed that, by the end of the intervention, expectations about exercise outcomes had an effect on physical activity independent of their baseline self-efficacy.

One direction for future studies is to focus on how specific control beliefs behave within the context of others to predict physical activity in the face of limitations imposed by arthritis symptoms. This may be accomplished by testing the way in which control beliefs interact with each other. Future research should also investigate a relationship between control beliefs and symptoms among individuals with more depression or less motivation. Interventions to change the way that individuals perceive their ability to influence their pain may need to take place before they employ self-management strategies that may improve symptoms (Quartana et al., 2009).

Education was additionally predictive of self-reported post-test physical activity frequency and significantly correlated in bivariate analyses with better physical activity outcomes. This finding could have implications for future versions of *ALED*, for program materials could be modified to better meet needs of those with lower education levels. Modifications in content might include targeting materials to a different grade level.

Emphasis is increasingly being placed on incorporating non-pharmacological approaches to provide a multimodal approach to managing arthritis symptoms. Evidence has shown that physical activity that matches one's lifestyle and preferences can function as a non-pharmacological approach,

providing substantial health benefits for people with arthritis. But some people have better outcomes than others, in part due to limitations imposed by arthritis symptoms and control beliefs. Given the importance of perceived control in managing arthritis, it will be important to refine interventions among this population to target control beliefs and reach as many people as possible.

7. LITERATURE CITED

- 2008 Physical Activity Guidelines Advisory Committee. (2008). *Physical activity guidelines advisory committee report*. U.S. Department of Health and Human Services.
- Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. R., Jr, Montoye, H. J., Sallis, J. F., et al. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise*, 25(1), 71-80.
- Allison, P. D. (2001). *Missing data*. Thousand Oaks, Calif.: Sage Publications.
- American College of Sports Medicine. (2008). *ACSM, AHA support Federal physical activity guidelines. U.S. recommendations reflect previously published ACSM/AHA guidelines*. Retrieved May 12, 2009, from <http://www.acsm.org/AM/Template.cfm?Section=Home&TEMPLATE=/CM/HTMLDisplay.cfm&CONTENTID=11398>
- Arthritis Foundation. (1999). *National arthritis action plan: A public health strategy*.
- Backman, C. L. (2006). Arthritis and pain. Psychosocial aspects in the management of arthritis pain. *Arthritis Research & Therapy*, 8(6), 221.
- Bandura, A. (1986). *Social foundations of thought and action :A social cognitive theory*. Englewood Cliffs, N.J.: Prentice-Hall
- Bandura, A. (1997). *Self-efficacy :The exercise of control*. New York: W.H. Freeman.
- Bandura, A. (1999). Social cognitive theory: An agentic perspective. *Asian Journal of Social Psychology*, 2(1).
- Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, 31(2), 143-164.
- Blair, S. N., Dunn, A. L., Marcus, B. H., Carpenter, R. A., & Jaret, P. (2001). *Active Living Every Day*. Champaign, IL: Human Kinetics.
- Boutaugh, M. L. (2003). Arthritis foundation community-based physical activity programs: Effectiveness and implementation issues. *Arthritis and Rheumatism*, 49(3), 463-470.

- 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(3 Suppl 2), 172-183.
- Bykerk, V. P., & Keystone, E. C. (2005). What are the goals and principles of management in the early treatment of rheumatoid arthritis? *Best Practice & Research. Clinical Rheumatology*, 19(1), 147-161.
- Callahan LF, Mielenz T, Shreffler J, Donahue K, Hootman JM, & Brady T. (2006). A randomized trial (RCT) of Active Living Every Day (ALED) in individuals with arthritis [Abstract]. 54(9) S816-S817.
- Callahan, L. F., Schoster, B., Hootman, J., Brady, T., Sally, L., Donahue, K., et al. (2007). Modifications to the Active Living Every Day (ALED) course for adults with arthritis. *Preventing Chronic Disease*, 4(3), A58.
- Callahan, L. F. (2009). Physical activity programs for chronic arthritis. *Current Opinion in Rheumatology*, 21(2), 177-182.
- Centers for Disease Control and Prevention (CDC). (2001). Prevalence of arthritis--United States, 1997. *MMWR.Morbidity and Mortality Weekly Report*, 50(17), 334-336.
- Centers for Disease Control and Prevention (CDC). (2002). Prevalence of self-reported arthritis or chronic joint symptoms among adults--United States, 2001. *MMWR.Morbidity and Mortality Weekly Report*, 51(42), 948-950.
- Centers for Disease Control and Prevention (CDC). (2006). State prevalence of self-reported doctor-diagnosed arthritis and arthritis-attributable activity limitation--United States, 2003. *MMWR.Morbidity and Mortality Weekly Report*, 55(17), 477-481.
- Centers for Disease Control and Prevention (CDC). (2008). Prevalence of self-reported physically active adults--United States, 2007. *MMWR. Morbidity and Mortality Weekly Report*, 57(48), 1297-1300.
- Chmura Kraemer, H., Kiernan, M., Essex, M., & Kupfer, D. J. (2008). How and why criteria defining moderators and mediators differ between the Baron & Kenny and MacArthur approaches. *Health Psychology*, 27(2), S101-S108.
- Conn, V. S., Hafdahl, A. R., Minor, M. A., & Nielsen, P. J. (2008). Physical activity interventions among adults with arthritis: Meta-analysis of outcomes. *Seminars in Arthritis and Rheumatism*, 37:307-316.

- Covic, T., Tyson, G., Spencer, D., & Howe, G. (2006). Depression in rheumatoid arthritis patients: Demographic, clinical, and psychological predictors. *Journal of Psychosomatic Research*, 60, 469-476.
- Cress, M. E., Buchner, D. M., Prohaska, T., Rimmer, J., Brown, M., Macera, C., et al. (2005). Best practices for physical activity programs and behavior counseling in older adult populations. *Journal of Aging and Physical Activity*, 13(1), 61-74.
- Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227.
- Der Ananian, C., Wilcox, S., Watkins, K., Saunders, R., & Evans, A. E. (2008). Factors associated with exercise participation in adults with arthritis. *Journal of Aging and Physical Activity*, 16(2), 125-143.
- DeVellis, B. M., & DeVellis, R. F. (2000). Self-efficacy and health. In A. Baum, T. A. Revenson & J. E. Singer (Eds.), *Handbook of health psychology* (pp.235-247). Mahwah, N.J. : Lawrence Erlbaum Associates.
- DeVellis, B. M. (1995). The psychological impact of arthritis: Prevalence of depression. *Arthritis Care and Research : The Official Journal of the Arthritis Health Professions Association*, 8(4), 284-289.
- DeVellis, R. F., & Callahan, L. F. (1993). A brief measure of helplessness in rheumatic disease: The helplessness subscale of the rheumatology attitudes index. *The Journal of Rheumatology*, 20(5), 866-869.
- Dickens, C., McGowan, L., Clark-Carter, D., & Creed, F. (2002). Depression in rheumatoid arthritis: A systematic review of the literature with meta-analysis. *Psychosomatic Medicine*, 64(1), 52-60.
- Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion. (2008). *Communication campaigns. Physical activity. The arthritis pain reliever*. Retrieved May 12, 2009, from http://www.cdc.gov/arthritis/campaigns/physical_activity/index.htm
- Dunn, A. L., Andersen, R. E., & Jakicic, J. M. (1998). Lifestyle physical activity interventions. History, short- and long-term effects, and recommendations. *American Journal of Preventive Medicine*, 15(4), 398-412.
- Dunn, A. L., Garcia, M. E., Marcus, B. H., Kampert, J. B., Kohl, H. W., & Blair, S. N. (1998). Six-month physical activity and fitness changes in Project Active, a randomized trial. *Medicine and Science in Sports and Exercise*, 30(7), 1076-1083.

- Dunn, A. L., Marcus, B. H., Kampert, J. B., Garcia, M. E., Kohl, H. W., III, & Blair, S. N. (1999). Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: A randomized trial. *JAMA : The Journal of the American Medical Association*, 281(4), 327-334.
- Edwards, R. R., Bingham, C. O., III, Bathon, J., & Haythornthwaite, J. A. (2006). Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. *Arthritis Care & Research*, 55(2), 325-332.
- Fontaine, K., & Haaz, S. (2006). Risk factors for lack of recent exercise in adults with self-reported, professionally diagnosed arthritis. *Journal of Clinical Rheumatology*, 12(2), 66-69.
- Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research: Correction to Frazier et al. (2004). *Journal of Counseling Psychology*, 51(2), 157-157.
- Gill, T. M., Williams, C. S., & Tinetti, M. E. (1995). Assessing risk for the onset of functional dependence among older adults: The role of physical performance. *Journal of the American Geriatrics Society*, 43(6), 603-609.
- Goldenberg, D. L. (2009). The interface of pain and mood disturbances in the rheumatic diseases. *Seminars in Arthritis and Rheumatism*.
- Harada, N. D., Chiu, V., King, A. C., & Stewart, A. L. (2001). An evaluation of three self-report physical activity instruments for older adults. *Medicine and Science in Sports and Exercise*, 33(6), 962-970.
- Harris, A.H.S., Cronkite, R., & Moos, R. (2006). Physical activity, exercise coping, and depression in a 10-year cohort study of depressed patients. *Journal of Affective Disorders*, 93, 79-85.
- Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39(8), 1423-1434.
- Holman, H., & Lorig, K. (2004). Patient self-management: A key to effectiveness and efficiency in care of chronic disease. *Public Health Reports (Washington, D.C.: 1974)*, 119(3), 239-243.
- Hootman, J. M., & Helmick, C. G. (2006). Projections of U.S. prevalence of arthritis and associated activity limitations. *Arthritis and Rheumatism*, 54(1), 226-229.

- Hughes, S. L., Seymour, R. B., Campbell, R., Pollak, N., Huber, G., & Sharma, L. (2004). Impact of the Fit and Strong intervention on older adults with osteoarthritis. *The Gerontologist*, 44(2), 217-228.
- Issa, S., & Sharma, L. (2006). Epidemiology of osteoarthritis: An update. *Current Rheumatology Reports*, 8(1), 7-15.
- Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., et al. (2002). The effectiveness of interventions to increase physical activity. A systematic review. *American Journal of Preventive Medicine*, 22(4 Suppl), 73-107.
- Kohl, H. W., 3rd, Dunn, A. L., Marcus, B. H., & Blair, S. N. (1998). A randomized trial of physical activity interventions: Design and baseline data from Project Active. *Medicine and Science in Sports and Exercise*, 30(2), 275-283.
- Lewis, B. A., Marcus, B. H., Pate, R. R., & Dunn, A. L. (2002). Psychosocial mediators of physical activity behavior among adults and children. *American Journal of Preventive Medicine*, 23(2 Suppl), 26-35.
- Lin, E. H. (2008). Depression and osteoarthritis. *The American Journal of Medicine*, 121(11 Suppl 2), S16-9.
- Lorig, K., Chastain, R. L., Ung, E., Shoor, S., & Holman, H. R. (1989). Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. *Arthritis and Rheumatism*, 32(1), 37-44.
- Lorig, K. R., & Holman, H. (2003). Self-management education: History, definition, outcomes, and mechanisms. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine*, 26(1), 1-7.
- Lorig, K. (1996). *Outcome measures for health education and other health care interventions*. Thousand Oaks, Calif.: Sage Publications.
- Lucas, R., & Baird, B. (2005). Global self-assessment. In M. Eid, & E. Diener (Eds.), *Handbook of multimethod measurement in psychology* (2005). Washington, DC: American Psychological Association.
- MacKinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science : The Official Journal of the Society for Prevention Research*, 1(4), 173-181.
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7(1), 83-104.

- MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. New York: Lawrence Erlbaum Associates.
- Maddux, J. E. (1995a). Looking for common ground: A comment on Kirsch and Bandura. *Self-efficacy, adaptation, and adjustment :Theory, research, and application* (pp. 377-385). New York: Plenum Press.
- Maddux, J. E. (1995b). Self-efficacy theory: An introduction. *Self-efficacy, adaptation, and adjustment :Theory, research, and application* (pp. 3-26). New York: Plenum Press.
- Maes, S., & Karoly, P. (2005). Self-regulation assessment and intervention in physical health and illness: A review. *Applied Psychology-an International Review-Psychologie Appliquee-Revue Internationale*, 54(2), 267-299.
- Marquez, D. X., Bustamante, E. E., Blissmer, B. J., & Prohaska, T. R. (2009). Health promotion for successful aging. *American Journal of Lifestyle Medicine*, 3(1), 12.
- McAuley, E., & Morris, K. S. (2007). State of the art review: Advances in physical activity and mental health: Quality of life. *American Journal of Lifestyle Medicine*, 1, 389.
- McAuley, E., Morris, K. S., Motl, R. W., Hu, L., Konopack, J. F., & Elavsky, S. (2007). Long-term follow-up of physical activity behavior in older adults. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association*, 26(3), 375-380.
- McGraw, K., McGraw, C., & American College of Sports Medicine. (2003). *ACSM's exercise management for persons with chronic diseases and disabilities* (2nd ed.). Champaign, Ill.: Human Kinetics.
- McIlvane, J. M., Schiaffino, K. M., & Paget, S. A. (2007). Age differences in the pain-depression link for women with osteoarthritis. Functional impairment and personal control as mediators. *Women's Health Issues : Official Publication of the Jacobs Institute of Women's Health*, 17(1), 44-51.
- Mease, P. (2005). Fibromyalgia syndrome: Review of clinical presentation, pathogenesis, outcome measures, and treatment. *The Journal of Rheumatology. Supplement*, 75, 6-21.
- Meyers, L. S., Gamst G., Guarino A. J. (2006). *Applied multivariate research: Design and interpretation*. Thousand Oaks : SAGE Publications.

- Mirowsky, J., & Ross, C. E. (2007). Life course trajectories of perceived control and their relationship to education. *American Journal of Sociology*, 112(5), 1339-1382.
- Motl, R. W., Snook, E. M., McAuley, E., & Gliottoni, R. C. (2006). Symptoms, self-efficacy, and physical activity among individuals with multiple sclerosis. *Research in Nursing & Health*, 29(6), 597-606.
- National Center for Chronic Disease Prevention and Health Promotion. (2009, November 4). *Arthritis Intervention Programs*. Retrieved from <http://www.cdc.gov/arthritis/intervention/>
- Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., et al. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39(8), 1435-1445.
- Oliver, K., & Cronan, T. A. (2005). Correlates of physical activity among women with fibromyalgia syndrome. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine*, 29(1), 44-53.
- O'Rourke, N., Hatcher, L., & Stepanski, E. J. (2005). *A step-by-step approach to using SAS for univariate & multivariate statistics*. New York : Wiley-Interscience ;Cary, NC : SAS Institute.
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40(3), 879-891.
- Quartana, P. J., Campbell, C. M., & Edwards, R. R. (2009). Pain catastrophizing: A critical review. *Expert Review of Neurotherapeutics*, 9(5), 745-758.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1(3), 385-401.
- Rasch, E. K., Hirsch, R., Paulose-Ram, R., & Hochberg, M. C. (2003). Prevalence of rheumatoid arthritis in persons 60 years of age and older in the United States: Effect of different methods of case classification. *Arthritis and Rheumatism*, 48(4), 917-926.
- Rejeski, W. J., & Brawley, L. R. (2006). Functional health: Innovations in research on physical activity with older adults. *Medicine and Science in Sports and Exercise*, 38(1), 93-99.

- Resnick, B. (2001). Testing a model of exercise behavior in older adults. *Research in Nursing & Health*, 24(2), 83-92.
- Resnick, B., & Jenkins, L. S. (2000). Testing the reliability and validity of the self-efficacy for exercise scale. *Nursing Research*, 49(3), 154-159.
- Resnick, B., Zimmerman, S. I., Orwig, D., Furstenberg, A. L., & Magaziner, J. (2000). Outcome expectations for exercise scale: Utility and psychometrics. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 55(6), S352-6.
- Rikli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. Champaign, IL: Human Kinetics.
- Rosemann, T., Backenstrass, M., Joest, K., Rosemann, A., Szecsenyi, J., & Laux, G. (2007). Predictors of depression in a sample of 1,021 primary care patients with osteoarthritis. *Arthritis and Rheumatism*, 57(3), 415-422.
- Rudd, R. E., Rosenfeld, L., & Gall, V. (2007). Health literacy and arthritis research and practice. *Current Opinion in Rheumatology*, 19(2), 97-100.
- SAS Institute Inc. (2003). SAS v.9.1. Cary, NC: SAS Institute Inc.
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology*, 57(1), 1-29.
- Shih, M., Hootman, J. M., Kruger, J., & Helmick, C. G. (2006). Physical activity in men and women with arthritis. National Health Interview Survey, 2002. *American Journal of Preventive Medicine*, 30(5), 385-393.
- Shih, M., Hootman, J. M., Strine, T. W., Chapman, D. P., & Brady, T. J. (2006). Serious psychological distress in U.S. adults with arthritis. *Journal of General Internal Medicine : Official Journal of the Society for Research and Education in Primary Care Internal Medicine*, 21(11), 1160-1166.
- Singer, J. D. In Willett J. B. (Ed.), *Applied longitudinal data analysis : Modeling change and event occurrence*. Oxford ;New York : Oxford University Press, 2003.
- Singh, M. A. (2004). Exercise and aging. *Clinics in Geriatric Medicine*, 20(2), 201-221.

- Stang, P. E., Brandenburg, N. A., Lane, M. C., Merikangas, K. R., Von Korff, M. R., & Kessler, R. C. (2006). Mental and physical comorbid conditions and days in role among persons with arthritis. *Psychosomatic Medicine*, *68*(1), 152-158.
- Steffen, T. M., Hacker, T. A., & Mollinger, L. (2002). Age- and gender-related test performance in community-dwelling elderly people: Six-minute walk test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Physical Therapy*, *82*(2), 128-137.
- Stewart, A. L., Mills, K. M., King, A. C., Haskell, W. L., Gillis, D., & Ritter, P. L. (2001). CHAMPS physical activity questionnaire for older adults: Outcomes for interventions. *Medicine and Science in Sports and Exercise*, *33*(7), 1126-1141.
- Stewart, A. L., Verboncoeur, C. J., McLellan, B. Y., Gillis, D. E., Rush, S., Mills, K. M., et al. (2001). Physical activity outcomes of CHAMPS II: A physical activity promotion program for older adults. *Journal of Gerontology*, *56A*(8), M465-M470.
- Strine, T. W., Hootman, J. M., Okoro, C. A., Balluz, L., Moriarty, D. G., Owens, M., et al. (2004). Frequent mental distress status among adults with arthritis age 45 years and older, 2001. *Arthritis Care & Research*, *51*(4), 533-537.
- Suomi, R., & Collier, D. (2003). Effects of arthritis exercise programs on functional fitness and perceived activities of daily living measures in older adults with arthritis. *Archives of Physical Medical Rehabilitation*, *84*, 1589-1594.
- Theis, K. A., Helmick, C. G., & Hootman, J. M. (2007). Arthritis burden and impact are greater among U.S. women than men: Intervention opportunities. *Journal of Women's Health* (2002), *16*(4), 441-453.
- U.S. Department of Health and Human Services. (2000). *Healthy people 2010 (Conference edition, in two volumes)*. Washington, DC.
- Villaire, M., & Mayer, G. (2007). Low health literacy: The impact on chronic illness management. *Professional Case Management*, *12*(4), 213-6; quiz 217-8.
- Wilcox, S., Castro, C. M., & King, A. C. (2006). Outcome expectations and physical activity participation in two samples of older women. *Journal of Health Psychology*, *11*(1), 65-77.

- Wilcox, S., Dowda, M., Dunn, A., Ory, M. G., Rheaume, C., & King, A. C. (2009). Predictors of increased physical activity in the Active for Life program. *Preventing Chronic Disease*, 6(1), A25.
- Wilcox, S., Dowda, M., Leviton, L. C., Bartlett-Prescott, J., Bazzarre, T., Campbell-Voytal, K., et al. (2008). Active For Life: Final results from the translation of two physical activity programs. *American Journal of Preventive Medicine*, 35(4), 340-351.
- Wilcox, S., Ananian, C. D., Sharpe, P. A., Robbins, J., & Brady, T. (2005). Correlates of physical activity in persons with arthritis: Review and recommendations. *Journal of Physical Activity & Health*, 2(2), 230.
- Williams, D. M., Anderson, E. S., & Winett, R. A. (2005). A review of the outcome expectancy construct in physical activity research. *Annals of Behavioral Medicine*, 29(1), 70-79.
- Wolfe, F., & Michaud, K. (2009). Predicting depression in rheumatoid arthritis: The signal importance of pain extent and fatigue, and comorbidity. *Arthritis Care & Research*, 61(5), 667-673.