HEALTHY MIND, HEALTHY BODY: MODELING PSYCHOLOGICAL DETERMINANTS OF PHYSICAL ACTIVITY IN MIDLIFE

by

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Physical activity (PA) is an important determinant of health and well-being, with particular relevance in midlife given increased sedentary behavior and incidence of chronic diseases with age. Understanding the relevant and modifiable determinants of PA in this population is important to inform interventions and public health policy. The present paper examined social-cognitive correlates (self-efficacy, self-regulation, and outcome expectations) of PA among 225 community-dwelling middle-aged adults aged 45-64. Univariate analyses indicated an association between select health-related variables and physical activity engagement in this sample. The hypothesized structural equation model predicted 63% of the variance in PA from direct effects of latent variables of self-efficacy beliefs about PA, attitudes about PA, and self-regulation skills. The best fitting model included an indirect path from outcome expectations to PA via influences on self-efficacy and self-regulation on PA. Self-reported physical activity presented the most notable limitation. Future studies should extend these findings using longitudinal, objective PA data to inform a multipronged approach that addresses both an individual’s PA behavior as well as the contexts in which it occurs.

*Keywords*: Physical activity, middle-age, structural equation modeling
DEDICATION

I dedicate this dissertation to the memory of my father, Stephen John Renn, who instilled in me the aspiration and confidence to achieve whatever I set my mind to, tempered with the value of humility and kindness. Dad, you were right—I was in school forever!

_Ua ola loko i ke aloha_  

_(Love gives life within)_
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# TABLE OF CONTENTS

CHAPTE

1. INTRODUCTION .........................................................................................1
   a. Physical Activity ..................................................................................3
   b. Theories of Health Promotion .............................................................8
   c. Previous Modeling .............................................................................14
   d. The Present Study ..............................................................................20

2. METHOD ......................................................................................................22
   a. Participants .......................................................................................22
   b. Procedure ..........................................................................................23
   c. Measures ...........................................................................................25
   d. Data Analysis .....................................................................................35

3. RESULTS ......................................................................................................40
   a. Participants Characteristics ...............................................................40
   b. Physical Activity ................................................................................40
   c. Model Variables .................................................................................46
   d. Measurement Model ..........................................................................48
   e. Structural Model ................................................................................49

4. DISCUSSION ................................................................................................56
   a. Limitations ........................................................................................64
b. Implications .............................................................. 69

c. Directions for Future Research ................................. 70

REFERENCES .................................................................................................... 73

APPENDIX A ...................................................................................................... 86

APPENDIX B ...................................................................................................... 87
# TABLES

1. Means, Standard Deviations, and Percentages for Demographic and Health Status Variables .................................................................41

2. Descriptive Statistics of the Measured Variables Used in the Structural Equation Model ........................................................................43

3. Intercorrelations of Measured Variables Used in the Structural Equation Model of Physical Activity ............................................................45

4. Model Fit Indices ........................................................................................................52
FIGURES

1. Measurement model specifying three correlated latent exogenous variables, with factor loadings and squared multiple correlations of indicator variables.................................................................50

2. Structural equation model specifying three correlated latent variables with direct effects on physical activity, with factor loadings and squared multiple correlations.........................................................51

3. Nested model specifying indirect effects of attitudes and outcome expectations on PA, via correlation with self-efficacy and self-regulation ........................................................................................53

4. Nested model specifying indirect effects of self-regulation and attitudes and outcome expectations on PA, via self-regulation ................55
CHAPTER 1
INTRODUCTION

Correlates of Physical Activity Engagement in Midlife:
A Structural Equation Model

Physical activity (PA) is a key health behavior with serious implications for disease morbidity, quality of life, and mortality. Despite the evidence for benefits of regular PA, self-report data from nationally representative surveys in the United States suggest that only 25-33% of adults adhere to recommended PA levels (Troiano, 2005); the most recent national statistics place this proportion at 20.4% of adults (National Center for Health Statistics, 2015). When the definition of PA is broadened to allow recreation, household, and transportation activity, adherence increases to 51.6% (Centers for Disease Control and Prevention [CDC], 2014b). However, a quarter (25.4%) of adults report no leisure-time physical activity (CDC, 2005). Furthermore, rates of PA decline with age, such that only 15.7% of adults aged 55-64 meet recommended activity levels (National Center for Health Statistics), with further decreases in subsequent decades (i.e., 10% of adults aged 70-plus; Tucker, Welk, & Beyler, 2011).

Estimates of PA vary according to assessment method. Despite these differences in estimates and measurement, one can infer that physical activity is variable and tends to decline with age. More so, physical inactivity is a critical health problem in the United States. Consequences of physical inactivity include increased risk for cardiovascular
disease, cancer, type 2 diabetes mellitus (T2DM), and other non-communicable diseases (World Health Organization [WHO], 2014). National and international health organizations have a vested interest in promoting physical activity as a modifiable risk factor for global disease burden. For example, the CDC has a dedicated Division of Nutrition, Physical Activity, and Obesity, which advocates that physical activity is crucial for improving the health of Americans. The Oxford Health Alliance (2009) has identified physical inactivity as one of the three key health behaviors (including tobacco use and diet) responsible for approximately 50% of global mortality. Furthermore, the WHO implicates physical inactivity as the fourth leading risk factor for mortality worldwide, estimating that 3.2 million deaths each year are related to physical inactivity.

Given the ubiquity of physical inactivity, particularly in developed nations such as the U.S., determinants of PA are likely multifaceted. Edwards and Tsouros (2006) proposed an ecological model of PA, in which broader environmental contexts, in concert with social and individual determinants, influence PA engagement. Macro factors in the natural environment such as weather and topography are likely one set of determinants of PA; built environment factors such as green space and urban design are another layer of determinants. Just as important are social and individual determinants of PA. These factors are based on various health promotion models and include self-efficacy, barriers, knowledge, and social support. Furthermore, there are likely subfacets of social and individual determinants of PA that vary by cohort, for reasons such as age, cultural influences and norms, and historical and developmental factors.

There is a scarcity of literature examining psychological factors associated with PA in middle-aged adults. Midlife represents a key developmental time point for health
promotion and forestalling age-related chronic disease processes associated with physical inactivity. As such, the present study sought to examine correlates of PA engagement in adults 45-64 years of age. The purpose of this paper is as follows: 1) review the importance of PA in this population; 2) review the theoretical basis for health promotion, as applied to PA; 3) review the literature on PA interventions in this population; and 4) test a structural equation model of correlates of PA in a middle-aged sample of community-dwelling adults.

Physical Activity

In discussing PA, the standard definition used in the field is “any bodily movement produced by skeletal muscle that results in energy expenditure” (Caspersen, Powell, & Christensohn, 1985, p. 128). The term *exercise*, though often used interchangeably with PA, is more precisely a subset of PA that is “planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (Caspersen et al., p. 128). The general consensus for PA guidelines is 150 minutes of moderate-to-vigorous physical activity (MVPA) weekly (Garber et al., 2011; Physical Activity Guidelines Advisory Committee, 2008; WHO, 2014). For those limited by chronic conditions and/or disabilities and not able to achieve 150 minutes of weekly MVPA, the 2008 Physical Activity Guidelines for Americans encourages such individuals to be “as physically active as their abilities and conditions allow.” (p. vii) with the acknowledgement that any level of PA is better than none, even in short episodes of activity (i.e., a minimum of 10 minutes). More extensive health benefits are associated with moving beyond the minimum requirement, such as increasing PA to 300 minutes per week of MVPA, as well as supplementing aerobic
activity with muscle-strengthening activities, stretching, and balance exercises (Physical Activity Guidelines Advisory Committee).

**Benefits of physical activity.** Regular PA has been associated with a reduced risk of disease complications, morbidity, and mortality across the adult lifespan. Specifically, participation in PA has been linked to improved cardiovascular health and prevention of cardiovascular disease (CVD; Warburton, Nicol, & Bredin, 2006), weight maintenance and prevention of metabolic dysfunction and obesity (particularly central adiposity; Shaw, Gennat, O’Rourke, & Del Mar, 2006), and prevention of certain cancers (e.g., breast, lung, endometrial, and colon; Eyre et al., 2004). The wide-reaching benefits of PA have implications for prevention, treatment, and rehabilitation of disease. For example, PA is associated with a reduced incidence of T2DM (Orozco et al., 2008); once diabetic, PA is also prescribed as adjunctive therapy for diabetes management (i.e., secondary and tertiary prevention) given the association of PA with improved glycemic control (Sigal, Kenny, Wasserman, & Castaneda-Sceppa, 2004). Exercise, as well as PA in general, is often recommended in the management of chronic pain (Chou et al., 2007; Scascighini, Toma, Dober-Spielmann, & Sprott, 2008), may improve sleep (Reid et al., 2010), and mitigates the symptoms of menopause (Sternfeld et al., 2004). These benefits extend well beyond the physical realm, with accumulating evidence suggesting PA is associated with reduced anxiety and depression (Carek, Laibstain, & Carek, 2011; Cooney et al., 2013) and increased quality of life (Elavsky et al., 2005).

While these myriad benefits of PA are evident across the lifespan, regular PA may have particular relevance to adults 50 and older (King & King, 2010). Age is highly associated with increased risk for the chronic conditions most amenable to PA (e.g.,
T2DM, CVD, cancer). Engaging in PA to offset the burden of chronic disease is particularly salient for this age group, as upwards of 80% of health problems associated with aging can be delayed or prevented by lifestyle changes in middle age (i.e., ages 55-65 years; Department of Health and Ageing, 2001). In addition to preventing frailty conditions like sarcopenia and osteoporosis, PA throughout middle adulthood can reduce functional limitations and reduce risk of falls and incidence of hip fracture in later life (Physical Activity Guidelines Advisory Council, 2008).

Furthermore, increasing physical activity at any phase of life confers benefits, even if an individual was previously sedentary. Epidemiological evidence indicates that current levels of PA, more so than previous PA patterns, are more predictive of major health outcomes such as mortality (Schnohr, Scharling, & Jensen, 2003). Even light lifestyle physical activity (LLPA), such as gardening or housework, has been found to influence mortality risk in community-dwelling adults, independent of other health correlates such as smoking, education, and comorbid health conditions (Manini et al., 2006). Manini and colleagues concluded that simply expending energy is enough to influence survival; specifically, for every 287 kilocalorie/day in activity energy expenditure, investigators found a 30% lower risk of mortality. These findings were replicated in Schnohr and colleagues’ examination of over 7,000 adults aged 20-93, in which maintaining or adopting a moderate level of PA was associated with lower mortality risk independent of age or sex. Even low levels of activity throughout the day conferred health benefits in previously sedentary individuals. Although the traditional focus of exercise science has been on MVPA, Pate and colleagues (2008) called for a shift toward a wider range of activities, including LLPA; however, few studies to date
have investigated this component of activity. Finally, more recent prospective cohort
data suggested that an increase in walking among sedentary adults in middle age was
significantly associated with a lower risk of functional disability five years later,
compared to adults who remained sedentary (Chou et al., 2014). Although there are
limitations to interpreting causality in these non-experimental data (e.g., individuals may
have remained sedentary during the study because of an insidious health limiting
condition that prevented activity and lowered functional ability), these findings held after
analyses were stratified by gender, age, and function status at baseline.

**Risks of sedentary behavior.** The benefits of PA are clear from the discussion
herein; conversely, sedentary behavior is associated with increased health risks and
mortality. Most concerning for middle-aged adults is the increased risk of cardiovascular
disease, T2DM, cancer, depression, dementia, and decline in physical function and
functional independence conferred by inactivity (Physical Activity Guidelines Advisory
Committee, 2008). Recent research has shown an even more startling trend: since 1999,
mortality has been increasing for middle-aged (aged 45-54), non-Hispanic Caucasian
adults (Case & Deaton, 2015). This increase in death rates is largely unprecedented in
the industrialized world over the last 50 years. Squires and Blumenthal (2016) argue that
this worrisome trend is due in large part to mortality from heart disease, which is in turn
strongly related to behavioral factors such as physical inactivity.

Addressing physical inactivity in middle adulthood provides opportunities to
forestall age-related physical and cognitive impairments and maintain quality of life.
Furthermore, reducing sedentary behavior in middle age may slow the aging process and
even increase survival in later life (Sun et al., 2010). Of particular relevance to middle-
aged adults are longitudinal findings from twin studies, in which Dahl and Hassing (2013) found that obesity in midlife was associated with lower cognitive performance across domains in late life. Although obesity is not a proxy for physical inactivity, the two states are correlated, and both promote low grade chronic pro-inflammatory states in the body that likely contribute to common age-related pathologies, such as dementia (“inflammaging;” Franceschi et al., 2000, 2007).

To clarify, sedentary behavior is not merely the inverse of PA. Sedentary behavior technically refers to activities with low energy expenditure (i.e., 1.0-1.5 metabolic equivalent of task [MET]; Pate, O’Neill, & Lobelo, 2008); practically, one can operationalize sedentary behavior as time spent sitting or lying down. Given our reliance on technology for work and leisure, it is perhaps not surprising that Americans spend the majority of their time in sedentary behavior (Matthews et al., 2008). The average older adult spends 8.5 waking hours per day in sedentary behavior; this amount continues to increase with age such that Americans aged 80 or older are more likely to be sedentary than those aged 60-79 (Evenson, Buchner, & Morland, 2012). Sedentary behavior in midlife is associated with having a higher BMI and demographic factors such as male sex and living in certain U.S. geographical regions (i.e., the southeastern U. S.; Diaz et al., 2016).

This trend toward increased sedentary behavior is alarming. An emerging literature base has positioned sedentary behavior as a health risk factor independent of PA. A recent review summarized the literature on sedentary behavior relative to health outcomes and found strong evidence for a link between sedentary behavior and T2DM, CVD, and all-cause mortality (Proper, Singh, van Mechelen, & Chinapaw, 2011).
Sedentary behavior predicts cardiometabolic health independent of physical activity levels (Henson et al., 2013). Another meta-analysis found that adults who spend more time in sedentary behaviors have increased odds of developing metabolic syndrome, independent of time spent engaging in PA (Edwardson et al., 2012). The clear benefits of PA and risks of inactivity, taken together, underscore the importance of better understanding PA in order to more effectively promote health.

**Theories of Health Promotion**

Increasing attention has been paid to the importance of PA in health promotion and chronic disease prevention during the last three decades. In particular, behavior change has been positioned as a key determinants in the initiation and maintenance of PA; therefore, a variety of theoretical models have been applied to better understand the potentially modifiable mechanisms associated with adherence to PA guidelines. Major theories represented in the PA literature include social cognitive theory (SCT; Bandura, 1986), the theory of planned behavior (TPB; Ajzen, 1991), and the transtheoretical model (TTM; Prochaska and Velicer, 1997). Researchers agree these popular models are more similar than dissimilar (Williams, Anderson, & Winett, 2005) and they share overlapping constructs such as self-efficacy, outcome expectations, and the importance of goal-setting. These three theories will be defined, with emphasis on SCT as the most widely used of the health behavior models. Then, an overview of previous modeling to apply SCT constructs will be reviewed. Finally, the present study investigating SCT correlates of PA in middle-aged adults will be presented.

**Theory of planned behavior.** Ajzen’s (1991) theory of planned behavior (TPB) posits a framework through which to predict behavior based on an individual’s attitudes,
perceived behavioral control, and subject norms. First, an individual’s attitude is his/her evaluation of engaging in a specific behavior, encompassing both outcome expectations (similar to SCT) and the relative value (positive or negative) of engaging in the behavior. According to TPB, a behavior is more likely if an individual holds a positive attitude about the behavior.

Secondly, perceived control refers to the individual’s perception of relative ease in achieving a desired outcome, as well as perceived ability to overcome barriers. The more favorable the individual perceives a behavior, and the greater he/she perceives control over behavioral outcomes, the more likely the individual will initiate and sustain the behavior. This construct is similar to self-efficacy (Bandura, 1977), in that it reflects an individual’s perceived ability to engage in a specific behavior. Perceived control was added to TPB after Ajzen’s earlier work (labeled “the theory of reasoned action”) was revised to include this necessary antecedent to health behavior change.

Thirdly, subjective norms refer to an individual’s normative beliefs about a specific behavior—that is, the perceived social pressure about what an individual should or should not do. Similar to attitudes, subjective norms also encompass beliefs espoused by others that an individual should engage in the behavior (e.g., a spouse who believes the other partner should exercise).

These three components (attitude toward the behavior, perceived behavioral control, and normative beliefs) are theorized to converge to influence both behavioral intentions (i.e., the plan to engage in a behavior) and actual behavioral outcomes. Behavioral intentions are an individual’s self-reported likelihood of performing the behavior, and are theorized to be a precursor to actual behavior. Critics of TPB argue
that forming strong intentions does not necessarily lead to behavior change, referred to as the “intention-behavior gap” (Armitage, 2005).

**Transtheoretical model.** The transtheoretical model (TTM; Prochaska & Velicer, 1997) was originally developed to understand behavior change related to smoking cessation, in which individuals are assessed to be at different stages of readiness for change (precontemplation, contemplation, preparation, action, and maintenance). Application of TTM to health promotion generally focuses on moving individuals along this continuum of readiness, in part by utilizing techniques from other health behavior change theories (e.g., leveraging self-efficacy, contingency management, stimulus control, social support; Prochaska & Velicer; Woodard & Berry, 2001). A systematic and comprehensive review of TTM and exercise interventions found that most studies have focused on Caucasian, middle-class populations, which limits the generalizability of published findings (Spencer, Adams, Malone, Roy, & Yost, 2006). Furthermore, these authors concluded that the construct validity of TTM and evidence for stage-based interventions is mixed. Tailored interventions based on TTM have not facilitated maintenance of behavior change (Adams & White, 2003). However, TTM’s utility may be as a moderator between interventions and behavior. Bauman and colleagues (Bauman, Sallis, Dzewaltowski, & Owen, 2002) posited this notion over a decade ago, questioning whether some mediators of change may be effective at early stages of readiness for change, whereas others may play a role in maintenance stages. However, the role of TTM as a moderator or mediator of physical activity interventions has not been demonstrated to date.

**Social cognitive theory.** Almost two decades ago, the Surgeon General
recommended a SCT framework for studying and promoting PA (U.S. Department of Health & Human Services [USDHHS], 1996). As a likely consequence, SCT has remained one of the most widely researched theories of health behavior change (Anderson, Wojcik, Winett, & Williams, 2006). Individual intervention strategies based on SCT have consistently demonstrated effectiveness in the adoption and adherence to PA during treatment; however, a gap remains between controlled research interventions and population-level dissemination, as evidenced by the low levels of national adherence to PA guidelines.

SCT posits a reciprocal influence between personal, environmental, and behavioral factors in determining behavior. The personal factors most relevant to PA behavior include demographic variables, self-efficacy, outcome expectations, and self-regulation (Anderson et al., 2006). Of these, self-efficacy is the core construct of the theory and refers to one’s perceived capabilities to master a task or behavior, or to cope in specific situations (Bandura, 1997). Self-efficacy is informed by *enactive mastery experience* (i.e., previous successes), *vicarious experience* (i.e., seeing another similar individual successfully perform the action), *verbal persuasion* (e.g., hearing praise about one’s capabilities from others), and *physiological or affective feedback* after an action (e.g., positive emotions will strengthen self-efficacy; Bandura, 1977). Self-efficacy is consistently found to be a determinant of PA in the empirical literature (McAuley & Blissmer, 2000; Williams & French, 2011), and high exercise self-efficacy has been shown to predict long-term behavior change (Sniehotta, Scholz, & Schwarzer, 2005).

Research in SCT interventions has shifted focus to best conceptualizing and intervening on self-efficacy. In a review of 27 studies, there was a small but significant effect of
interventions to increase self-efficacy for exercise ($d = .16$, $p < .001$, Ashford, Edmunds, & French, 2010). Generally, efficacy beliefs are thought to be critical to the adoption of exercise, but are likely less influential than other processes (e.g., self-regulatory skills) in maintenance of behavior change (Bandura; Woodard & Berry, 2001). For example, it may be that although an individual feels competent in initiating a health behavior change, he/she does not perceive sufficient value (i.e., outcome expectations) or have the appropriate behavioral skills (i.e., self-regulatory skills) to adhere to regular PA in the long-term. A more recent meta-analysis of PA interventions found that maintenance of exercise, compared to adoption, is differentially influenced by one’s perceived capability at overcoming barriers to exercise such as weather, fatigue, or boredom (i.e., barrier self-efficacy; Higgins, Middleton, Winner, & Janelle, 2014). The role of self-efficacy in maintaining change over time remains unclear.

Among younger adults, these three SCT variables have demonstrated consistent relationships with exercise behavior, with self-efficacy receiving the most attention (see Umstattd & Hallam, 2007 for a review). However, the application of these variables with other age groups is mixed; as with younger adults, self-efficacy is seemingly the most studied. Research findings are mixed, possibly due to publication bias, differences between samples, and differences between measures used, but the general consensus is that while self-efficacy is important in the initiation of PA, the influence is less clear on maintenance of exercise (Higgins et al., 2014; McAuley, 1992).

Self-regulation is another identified behavioral factor associated with exercise adoption and maintenance (King, 2001). Self-regulation refers one’s ability to regulate one’s behavior or performance consistent with goals, which manifests in the literature as
goal-setting, contingency management (i.e. use of reinforcement), self-monitoring, self-evaluation of performance with necessary corrections, and preparation to meet or avoid outcome expectations (Bandura, 1986). Maes and Karoly (2005) highlighted goal-setting and planning as central processes underlying self-regulatory behavior; both are widely associated with health behavior change and physical activity maintenance (Michie, Abraham, Whittington, McAteer, & Gupta, 2009).

Finally, SCT accounts for individual outcome expectations associated with a particular behavior such as exercise or PA. These initial outcome expectations are the person’s estimate that engaging in a specific behavior (such as exercise) will lead to a certain outcome (such as weight loss or improved cardiovascular health). This outcome expectation also hinges on how much the person values the anticipated outcome (Umstattd & Hallam, 2007). A behavior is more likely to occur when the individual believes it will result in positive outcomes of value to the individual. Outcome expectations have demonstrated mixed findings in the PA literature, possibly because of variability in measurement and sample characteristics. Furthermore, one might argue that outcome expectations and attitudes toward exercise are necessary but not sufficient for complex behavior change. For example, the actual reinforcement contingencies of outcome expectations of PA (e.g., weight loss) may be too distal to effectively control behavior.

Outcome expectations and self-regulation have not received as much study among middle-aged or older adults. In general, self-efficacy and self-regulation have been established as useful facilitators of physical activity in young adults (Zhou, Wang, Knoll, & Schwarzer, 2015). Self-regulation, as discussed above, has received increasing
attention as a key component of behavior change in general, and PA in particular. An emphasis on self-regulation is seen not just in SCT but also in other models such as self-determination theory (Ryan & Deci, 2000), control theory (Carver & Scheier, 1982), and goal theory (Locke & Latham, 1990). Self-regulation skills have also demonstrated efficacy in health behavior change interventions, independent of other behavior change techniques (Michie et al., 2009). Rhodes and Pfaeffl (2010) concluded that self-regulatory processes are the most likely mediators of PA based on a review of the experimental literature to increase PA across adult samples. However, outcome expectations are only sporadically included in interventions, so their relationship with PA in the context of other factors is unclear. This represents a lapse in the literature, as outcome expectancy is a core construct in a variety of health behavior models, including SCT, the theory of planned behavior, and the transtheoretical model.

Previous Modeling

Many, if not most, of the studies applying multivariate statistical modeling techniques to examine determinants of PA are based in SCT. One of the earliest studies to examine PA used path analysis to examine routine exercise behavior among adults aged 65 and older enrolled in an exercise program (Conn, 1998). SCT variables of outcome expectancy, self-efficacy, and barriers were examined among these independently living older adults. These variables, together with age, health, and lifelong exercise behavior accounted for 60% of the variance in exercise behavior. Perceived barriers to exercise asserted the largest effect on exercise behavior, both through direct effects and indirect effects on self-efficacy. Self-efficacy had the next largest effect. Health variables and age influenced exercise indirectly through paths to perceived
barriers and outcome expectancy, respectively. Lifelong participation in exercise was influential only inasmuch as it predicted self-efficacy beliefs. Outcome expectancy was a weak predictor of exercise behavior among these older adults.

Resnick (2001) also modeled SCT determinants of PA among older adults living in a retirement community. Using structural equation modeling (SEM), her model accounted for 40% of the variance in aerobic exercise. Similar to Conn’s (1998) model, higher self-efficacy was associated with higher levels of exercise. Contrary to Conn’s model, Resnick found that higher positive outcome expectations were also associated with increased levels of exercise. Other factors accounted for the observed variance in the model included chronic illness, prior exercise behavior, and physical and mental health.

McAuley and colleagues (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003) extended this work by using SEM to assess multiple indicators of PA maintenance among adults aged 60-75 years old. As part of a randomized controlled trial of an exercise intervention, psychological determinants of self-efficacy, exercise-induced affect, social support, and value judgments about exercise were collected. The best fitting model indicated that self-efficacy was the best predictor of PA maintenance. Social support and affect influenced PA indirectly through their paths to self-efficacy. Similar to Resnick’s (2001) findings, this model accounted for 40% of the variance in maintenance of PA.

Further evidence for self-efficacy comes from longitudinal data. A SEM using data from over 1,000 adults aged 20 and older suggested that exercise self-efficacy was the strongest predictor of subsequent exercise behavior, after controlling for age,
education, and income (Rimal, 2001). Knowledge about exercise exerted much weaker effects on exercise behavior. As is typical of the literature, the outcome variable of interest in this model was operationalized as MVPA.

The absence of self-regulation from this earlier work is notable and highlights the centrality of self-efficacy in SCT and theories of behavior change. However, self-regulation likely imparts meaningful direct effects on PA behavior. Umstattd and Hallam (2007) included the construct of self-regulation in an attempt to extend the literature typically focused on self-efficacy and outcome expectations. In their examination of older adults’ (60+) exercise behavior, they replicated previous findings that regular exercise was associated with demographic characteristics (being male, White, and married, and having higher income and education). Furthermore, bivariate analyses indicated that older adults who exercised more had higher levels of self-efficacy, were more likely to use self-regulatory strategies, and endorsed more positive outcome expectations of exercise. However, in a multivariate model (in which self-efficacy, self-regulation, and outcome expectations were simultaneously modeled with PA), self-regulation was the only variable independently associated with regular exercise in this sample. This finding positioned self-regulation as a critical component of PA, although directionality of the relationship cannot be inferred from the cross-sectional data. Furthermore, this sample was limited to adults 60 and older who were enrolled in an exercise intervention program. Individuals actively seeking an exercise intervention may likely differ from community-dwelling adults of mixed activity levels.

Other studies have contributed to this complex picture, with mixed results. One such example examined social cognitive determinants of PA in a church-based health
promotion study (Anderson et al., 2006). Anderson and colleagues examined self-efficacy, self-regulation, and outcome expectations in 999 adults (aged 18 and older) from southwest Virginia. Outcome expectations did not contribute to PA levels. Similar to the findings by Umstattd and Hallam (2007), self-regulation exerted the strongest effect on PA. Self-efficacy indirectly contributed to participants’ PA via self-regulation; when analyzed independently of self-regulation, self-efficacy had little effect on PA. Social support influenced PA by way of self-efficacy and self-regulation. These variables, together with age and race, explained 46% of the variance in PA. The authors later used SEM to examine the relationship between SCT variables and PA in those participants aged 40 and older; again, outcome expectations exerted little influence on PA (Anderson-Bill, Winett, Wojcik, & Williams, 2011). These findings further the understanding of correlates of PA among middle-aged and older adults; however, they are derived from participants in an exercise promotion program.

The influence of SCT-based variables on exercise and physical activity is well established, both through intervention studies and those using statistical modeling. However, the contribution of each construct as an independent predictor of PA behavior remains inconsistent. Furthermore, less research has been done on the broader construct of PA compared to the rigorously defined variable of exercise behavior. Finally, the predictors of PA adherence found in younger adult samples are unreliable in older adult populations (Schutzer & Graves, 2004). Although attention to older adults’ PA has increased in the last decade, little research has come forth based on middle-aged adults. Further investigation of this key health behavior in this understudied population is necessary to broaden understanding of this and inform individual and systems-level
interventions.

**Other factors.** The theories of health promotion and previous models provide a framework to test hypotheses of PA engagement. However, there are other variables not explicited in these models that may influence PA by exerting unique influence not solely accounted for by psychological processes (Anderson-Bill et al., 2011; Bandura, 1997; King & King, 2010). Epidemiological evidence suggests that lower levels of PA are associated with demographic factors such as greater age, being female, lower levels of education, lower household income, unemployment, living in rural or disadvantaged areas, and belonging to racial or ethnic minority groups (Harrison, McElduff, & Edwards, 2006; King & King). However, psychological processes likely mediate these influences. For example, an examination of 1,090 African American and European American adults aged 18-65 found that social and environmental factors influenced PA indirectly through individual factors such as self-efficacy and motivation (McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006). Similarly, the inverse effect of age on PA may be conflated with functional and cognitive limitations, which may reduce self-efficacy (particularly for overcoming barriers) or alter positive outcome expectations.

Health factors are associated with PA, such that those with poorer health engage in less PA and endorse less exercise self-efficacy; however, there are directionality issues such that low PA may be associated with poorer health (Anderson-Bill et al.). Epidemiological evidence suggests that individuals with higher BMI, poorer self-rated health, depressed affect, and who use tobacco are less likely to engage in PA; again, the cross-sectional nature of these data limits causal inferences (Harrison et al., 2006). Social factors, such as social support, have shown an effect on making exercise more or less
likely; however Anderson-Bill and colleagues also found that social support influenced PA inasmuch as it predicted increased self-regulatory behaviors (e.g., setting goals, planning, and self-monitoring) and self-efficacy for overcoming barriers.

In a broader social-ecological context, environmental variables such as access to safe exercise facilities support or impeded PA. However, these macro-level variables may not contribute to PA directly; rather, they likely influence PA indirectly through self-efficacy, self-regulation, and outcome expectations. For example, Anderson-Bill and colleagues found that African American adults in their sample engaged in less PA than their European American counterparts. However, race did not influence the effects of self-efficacy and self-regulation on PA among these individuals (i.e., those with greater self-efficacy engaged in more PA, regardless of race). It may be that race and sociodemographic factors influence self-efficacy through differential barriers and opportunities for mastery experiences, thereby indirectly influencing PA. Individuals who are ethnically diverse, low-income, of advanced age, and from other marginalized groups may encounter greater access barriers to PA; to the extent that these individuals have fewer mastery experiences or vicarious learning of PA behavior, these factors may contribute to lower self-efficacy.

A recent public health review by leading PA researchers (King & King, 2010) condensed these various health promotion models and other determinants of PA among middle-aged and older adults. The authors argued that PA engagement is influenced by a host of person-level variables, including attitudinal, cognitive, and behavioral variables. Based on their review of the exiting literature, they concluded that particularly salient correlates likely include self-efficacy; enjoyment of PA; outcome expectancy, including
expectation of benefits and barriers, and competence in using self-regulation skills (e.g., realistic goal-setting and self-monitoring). However, a review of 34 studies of middle-aged and older adults since 1991 concluded there remains insufficient evidence investigating determinants of PA in this population, based on inconsistent replication of constructs, varying methods of measuring constructs, and limited generalizability of sample characteristics (Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011).

The Present Study

King and King (2010) argue that the principal challenge is finding feasible ways to modestly increase PA behavior in age groups most at risk for sedentary behavior. Middle-aged adults are increasingly sedentary compared to younger cohorts, but are poorly represented in the exercise science literature. This segment of the population represents a key target for health promotion, as engaging PA in midlife may help establish an active lifestyle that continues into older adulthood and forestalls the medical and functional complications associated with physical inactivity. Given that most of the previous literature relies on young adults, older adults (65+), and those enrolled in physical activity interventions, broadening and replicating our understanding of correlates of PA is necessary for developing effective interventions.

The present study sought to replicate previous investigations of SCT correlates of PA using structural equation modeling (SEM) among community-dwelling middle aged adults of varying activity levels. This multivariate statistical technique gaining popularity in the field for the ability to summarize relationships between variables in a way that is parsimonious and accurately reflects the patterns observed in the data (Weston & Gore, 2006). In contrast to a bulk of the literature, all three central processes (self-efficacy
beliefs, self-regulatory strategies, and attitudes/outcome expectations on PA) were included. The outcome variable of interest in the proposed study is PA, defined as a combination of structured exercise sessions (MVPA) as well as LLPA. The model hypothesized correlations between the three SCT variables, and predicted direct paths from each of these variables to PA. Two alternative models tested 1) indirect, rather than direct, effects of outcome expectations and attitudes on PA through self-efficacy and self-regulation; and 2) self-regulation as a mediator of self-efficacy and outcome expectations on PA. Finally, descriptive characteristics related to PA among this understudied population segment were explored.
CHAPTER 2

METHOD

Participants

Participants were 225 community-dwelling adults between 45 and 64 years of age. Of these, 195 participants had complete data across measures and were retained for univariate analyses. The full sample was retained for SEM analyses. In addition to the age requirement, eligible participants were required to be able to read and speak English and have visual and cognitive abilities sufficient for reading and completing written material. No other exclusion criteria were specified to maximize diversity of respondents.

Sample size criteria. There is no consensus with regard to sample size criteria for SEM (Weston & Gore, 2006). Although most researchers advise a sample size of 10 participants for each parameter being estimated (Kline, 1998), the ratio of sample size to free parameters may be as low as 5:1 with certain model specification (i.e., large factor loading and multiple indicators for each latent variable; Bentler & Chou, 1987). Consistent with Bentler and Chou’s recommendation, some argue that sample size should be a decision based on the model design, such as using multiple indicators of a latent variable, using highly reliable indicators (alpha ≥ .85), and factoring in overall model complexity and desired goodness-of-fit (Jackson, 2001; Jackson, 2003; MacCallum, Browne, & Sugawara, 1996; Weston & Gore). A common rule-of-thumb advises a
minimum of 200 participants for any SEM (Weston & Gore). The present study recruited slightly more participants ($N = 225$) to achieve this minimum while allowing for flexibility to handle missing data and other unanticipated procedural and/or methodological issues.

**Procedure**

Data were collected over a six-month period between January and June 2015. The majority of participants were recruited from Colorado Springs, CO and surrounding communities using two primary strategies: (a) direct phone calls, as well as emails and mailed letters, to all adults aged 45-64 on the University of Colorado Springs (UCCS) Gerontology Center Participant Registry and UCCS Trauma Health and Hazards Center Participant Registry; and (b) recruitment at El Paso County jury duty. A total of 286 potential participants were contacted by the Principal Investigator (PI) and/or an undergraduate research assistant (RA) via contact information provided by the participant registries; of these, 83 completed the study, 20 declined participation, and the remainder ($n = 183$) did not respond to telephone calls, emails, and/or mailed letters inviting them to participate. The PI and/or RA attended four separate occasions of jury duty for recruitment. Other recruitment methods were employed to maximize sample size and diversity of participant characteristics, including (a) recruitment flyers distributed to age-eligible UCCS Aging Center clients; (b) recruitment flyers placed at all UCCS Health Circle clinics/facilities; (c) recruitment flyers placed at Peak Vista Community Health Centers Senior Health behavioral health offices; (d) brief study description and contact information for the PI included in an article about healthy aging published in *Life After 50*, a free monthly newspaper aimed at adults 50 years and older in the Pikes Peak region;
(e) five community presentations co-presented by the PI on the cognitive benefits of exercise; (f) attendance at regional Rotary Club and Lion Clubs meetings; (g) email advertisement for the study sent to UCCS faculty and staff listservs; (h) UCCS SONA system posting to recruit UCCS undergraduate students who were between the ages of 45-64 and/or for a course credit “finders’ fee” for undergraduate students who referred parents/grandparents who fit study criteria; (i) recruitment flyers placed at the YMCAs of the Pikes Peak Region; (j) recruitment flyers placed at all Pikes Peak Library District branch community bulletin boards and staff break rooms; (k) recruitment flyers posted at various local businesses, including coffee shops and the local AARP office; and (l) recruitment flyers distributed to age-eligible study participants in other UCCS Lane Center research studies. These methods yielded 25 participants who completed the study.

Participants met with the PI and/or an RA in UCCS Department of Psychology research space in Columbine Hall or the Lane Center ($n = 108$), or at the El Paso County courthouse ($n = 117$). Participants provided informed consent and completed the packet of study questionnaires (see Appendices A and B, respectively). Participant weight was collected by the PI and/or RA in a private room using a high-capacity (up to 400 lb) scale for participants seen at UCCS; however, logistical and privacy concerns at the courthouse necessitated that weight be self-reported for the remainder of the sample. Upon completion of the packet, the PI and/or RA briefly reviewed the questionnaires to ensure that items were not unintentionally missed. Participants typically completed the questionnaire packet in 20 to 30 min and were offered $5 cash incentive at the completion of the study (UCCS students were offered the alternative of course credit if they signed up through the SONA system; $n = 1$ utilized this method). All study
materials and procedures were approved by the UCCS Institutional Review Board (IRB; protocol #15-103; see Appendix C for IRB approval letters).

**Measures**

**Personal characteristics.** Participant demographics were collected as recommended by the American Psychological Association (APA; 2009) and included 1) age (reported by the participant and measured in chronological years), 2) gender (self-reported as male, female, or other), and 3) self-identified race and ethnicity. Race and ethnicity data were categorized according to the recommendations of the Office of Management and Budget used by the most recent U.S. Census guidelines (2010 Census guidelines, as set forth by Sink, 1997): 1) White (a person having origins in Europe, the Middle East, or North Africa), 2) Black or African American (a person having origins in any of the Black racial groups of Africa), 3) American Indian or Alaska Native (a person having origins in North and South America, including Central America, and who maintains, tribal affiliation or community attachment), 4) Asian (a person having origins in the Far East, Southeast Asia, or the Indian subcontinent), and/or 5) Native Hawaiian or other Pacific Islander (a person having origins in Hawaii, Guam, Samoa, or other Pacific Islands). Participants could also select more than one race, "other" (fill-in-the-blank), or choose to decline to respond. Given the lack of racial diversity in the sample, race was subjected to post-hoc dichotomization as Caucasian and non-Caucasian for univariate analyses. Ethnicity was reported as Hispanic or non-Hispanic. Participants reported 1) education attainment (years completed), 2) categorical self-reported household income, 3) categorical household assets, 4) employment status, and 5) relationship status. These questions are adapted from the National Health and Nutrition Examination Survey.
Health and psychosocial factors. As reviewed herein, a variety of health and psychosocial factors have demonstrated reciprocal relationships with PA. The study procedure was designed to minimize participant burden, so brief screening measures of the most prevalent health and psychosocial correlates of reduced PA were included: BMI, self-rated health, depression, pain, and loneliness.

**BMI.** Body weight, especially obesity, has been shown to affect initiation and maintenance of exercise (Sherwood & Jeffery, 2000). Excessive weight may be a barrier to exercise in middle-aged and older adults because obesity is associated with functional limitations, impaired upper- and lower body mobility, and reduced flexibility and strength (Clark, Stump, Hui, & Wolinsky, 1998; Ferraro, Su, Gretebeck, Black, & Badylak, 2002). Although body mass index (BMI) does not measure body fat, it correlates to direct measures of body composition and is considered an acceptable alternative for more expensive and invasive direct measures (Garrow & Webster, 1985; Mei et al., 2002). Therefore, body mass index (BMI) was included in the present study.

As mentioned above in the procedure, weight was initially collected via scale and subsequently self-reported by participants. Height was self-reported. Although self-reported weight and height tend to impart inaccurate estimates (namely, lower BMI by over-reporting height and underreporting weight), epidemiological research in middle-aged adults supports self-report for identifying relationships between variables, as inaccuracy in BMI is consistent (Spencer, Appleby, Davey, & Key, 2002). Using the CDC (2014a) recommendation, BMI was calculated according to the following formula: weight (lb) / [height (in)]^2 x 703. It was treated as a continuous variable in correlation
analyses, as well as categorized into CDC classes: normal (BMI = 18.0-24.9), overweight but not obese (BMI = 25.0-29.9), obese class 1 (low-risk obesity; BMI = 30.0-34.9), obese class 2 (moderate-risk obesity; BMI = 35.0-39.9), and obese class 3 (high-risk obesity; BMI ≥ 40).

**Depression.** The Patient Health Questionnaire-2 (PHQ-2; Kroenke, Spitzer, & Williams, 2003) is a two-item self-administered depression screen. The participant rates the frequency that he/she experiences the two cardinal symptoms of depression, depressed mood and anhedonia (0 = *not at all*, 3 = *nearly every day*). Scores range from 0 to 6, with higher scores suggesting a higher likelihood of clinically significant depressive symptomatology. The authors suggest a cut point of 3 for optimal sensitivity (82.9 for MDD and 62.3 for any depressive disorder) and specificity (90.0 for MDD and 95.4 for any depressive disorder), with a lower cut point of 2 yielding greater sensitivity and a cut point of 4 enhancing specificity. PHQ-2 sum score was treated as a continuous variable and dichotomized into clinical symptoms of depression (≥ 3) and no depression (< 3).

The PHQ-2 has strong internal reliability in primary care settings (Cronbach’s α = 0.83; Lowe, Kroenke, & Grafe, 2005) and was adequate in the present sample (α = .81). The convergent validity of the PHQ-2 with other established measures of depression is good (r = .67 to .87; Lowe et al.); likewise, the screen has strong construct validity established by functional status, disability days, and symptom-related difficulty (Kroenke et al., 2003). Furthermore, the psychometric properties of the PHQ-2 have been established with middle-aged outpatients (Lowe et al.).

**Self-rated health.** Self-rated health was assessed using a single item, “In general,
would you say your health is...” utilizing a five-item Likert-type response scale ranging from 1 = excellent to 5 = poor. The specific wording of this item was drawn from the National Health Interview Survey; however, a meta-analysis found that the concept of self-rated health was robust to semantic variations in the questions eliciting it (i.e., comparing one’s health to others the same age versus to others in general; Idler & Benyamini, 1997). This item has demonstrated good test-retest reliability ($r = .92$; Lorig et al., 1996). In general, self-rated health has been found to be a highly robust predictor of death (Idler & Benyamini). This association with mortality holds after adjusting for covariates such as functional status, depression, and comorbid illness (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006). Furthermore, cross-sectional evidence suggests that although individuals factor in physical, mental, and social dimensions when rating their health, self-rated health is most strongly associated with physical functioning (Mavaddat et al., 2011). This item is widely used in the literature as it takes seconds to collect and provides a direct way of capturing broad perceptions of health (DeSalvo et al.).

**Pain.** Presence and severity of pain was assessed using four items from the Brief Pain Inventory (BPI: Cleeland & Ryan, 1994). This measure is widely used across clinical, epidemiological, and research samples because it is brief, easy to understand, therefore limits respondent burden. Participants rated the four items (current pain, average pain, worst pain in the last week, and least pain in the past week) on an 11-point scale ($0 = no pain$, $10 = pain as bad as you can imagine$). Two items (average and worst pain) were selected for univariate analyses, as these are most likely to interfere with PA.

**Loneliness.** A brief scale assessing loneliness was included, as this emotional construct has demonstrated robust cross-sectional and longitudinal associations with
reduced PA in middle-aged adults, independent of other health, psychosocial, and demographic factors (Hawkley, Thisted, & Cacioppo, 2009). Although loneliness can be triggered by situational stressors, it is typically conceptualized as a trait as it tends to remain stable over young and middle adulthood and into later life (Pinquart & Sorensen, 2003).

Loneliness was assessed in the present study using the three-item Loneliness Scale (ULS; Hughes, Waite, Hawkley, & Cacioppo, 2004). This measure was adapted from the standard measure of loneliness, the revised UCLA Loneliness Scale (R-UCLA; Russell, Peplau, & Cutrona, 1980), in order to improve ease and feasibility of administration. Similar to the R-UCLA, the ULS was designed to be self-administered, with three items assessing the frequency of overall loneliness on a 4-point scale (1 = hardly ever, 4 = often). Items were summed for a summary score, with higher scores suggested greater loneliness. Internal consistency in the validation sample was .72; it was strong in the present sample (α = .89). The scale was created as part of a study of social isolation and health in the aging process, using a probability sample of U.S. adult aged 50-plus. This measure has demonstrated concurrent and discriminant reliability in the validation sample (Hughes et al.).

**Self-efficacy.** Exercise self-efficacy was assessed using the six-item Exercise Self-Efficacy Scale (EXSE; McAuley, 1993). This measure assessed participants’ beliefs in their ability to perform MVPA (i.e., exercise five times per week, at moderate intensities, for 30 minutes or more per session) at present and over the next eight weeks. The total scale score was derived by averaging the responses to the six items; the scale was scored on a 100-point percentage scale, ranging from 0% (not at all confident) to 100% (highly confident), with higher scores indicating greater self-efficacy. The EXSE
has demonstrated excellent internal consistency in samples of middle-aged and older adults ($\alpha = .90$ to .92; McAuley et al., 2005; White, Wójcicki, & McAuley, 2009); Cronbach’s alpha in the present sample was .98, suggesting possible redundancy in items (Tavakol & Dennick, 2011). This scale has been widely used in the social cognitive literature to understand PA among adults across the lifespan (McAuley et al., 2003; McAuley et al., 2005; McAuley et al., 2011; White et al.).

Another indicator of exercise self-efficacy was collected using a scale developed in a middle-aged sample by Bray and Cowan (2004). This 8-item measure assessed a respondent’s confidence in exercising for progressively longer time increments ranging from five to 40 min. Self-efficacy for each item was rated from 0% (not at all confident) to 100% (highly confident). The scale score represented the mean of the eight items, with higher scores indicating greater self-efficacy. The authors developed this measure based on Bandura’s (1997) recommendations for assessing self-efficacy via hierarchical, domain-specific items. This scale has shown acceptable internal consistency in the validation sample (.87; Bray & Cowan). The scale in the present sample had a very high Cronbach’s alpha (.97), again raising concern for redundancy in items.

Finally, barrier self-efficacy was assessed using McAuley’s (1992) Barrier Self-Efficacy Scale (BARSE), which was developed for sedentary middle-aged adults (aged 45-64 years) who participated in an exercise program. The barriers identified were determined through analysis of participant reasons for dropping out of exercise, including feeling bored with the activity, lack of social support, experiencing pain or discomfort, and feeling self-conscious about appearance. The 13-items were rated on a 100-point percentage scale, ranging from 0% (not at all confident) to 100% (highly confident). The
total scale score is derived by averaging the responses, with higher scores indicating greater self-efficacy. Internal consistency is high in both previous samples ($\alpha = .88-.94$; McAuley, 1992; McAuley et al., 2011) and the present sample ($\alpha = .93$).

**Self-regulation.** Participant use of self-regulatory strategies for physical activity was assessed using the Exercise Goal-Setting Scale (EGSS) and the Exercise Planning and Scheduling Scale (EPSS; Rovniak, Anderson, Winett, & Stephens, 2002). Subsequent factor analysis on adult samples (Elavsky, Doerksen, & Conroy, 2012) adapted Rovniak and colleagues’ original two-factor model to include three factors that emphasized content validity: 1) goal-setting practices (comprised of six items from EGSS), 2) deprioritization (based on four items from EPSS, changed to priority with reverse scoring for consistency with other indicators), and 3) planning/scheduling (based on four items from EPSS). This 14-item measure utilized a five-point response metric ($1 = \text{does not describe}, 5 = \text{describes completely}$). Scores for each of the three subscale were summed (select items are reverse-scored, including the deprioritization scale mentioned above). Higher summary scores indicated higher levels of the three constructs of goal-setting (range 6-30), prioritization (range 4-20), and planning/scheduling (range 4-20). Elavsky and colleagues’ work established external validity for these three distinctive self-regulatory processes, in addition to acceptable internal consistency ($\alpha = .79-.82$). Cronbach’s alpha estimates in the present sample were .84 for goal-setting (less than 1% missing data), .83 for prioritization (less than 2% missing data), and .82 (scheduling/planning (less than 1% missing data).

**Attitudes and outcome expectations.** Perceived benefits of and barriers to physical activity were assessed using the Exercise Benefits/Barriers Scale (EBBS;
Sechrist, Walker, & Pender, 1987). This 43-item scale assessed a variety of perceived consequences of exercise, including social, health, and environmental factors (e.g., social interaction and preventive health as potential benefits; physical exertion and exercise environment as potential barriers). This measure assessed two factors, benefits and barriers, supported by factor analysis (Sechrist et al.).

The EBBS contained 29 potentially beneficial outcomes of exercise and 14 items assessing perceived barriers. Participants endorsed their agreement with each statement using a 4-point Likert format (1 = strongly disagree to 4 = strongly agree); the Barriers scale items were reverse-scored. Total possible scores ranged from 43 to 172. Possible scores on the Benefits subscale ranged from 29 to 116, with higher scores indicating more positive perceptions of exercise. Possible Barriers subscale score ranged from 14 to 56, with higher scores suggesting fewer perceived barriers to exercise after reverse scoring. The EBBS Benefits subscale has been associated with regular exercise in adults aged 40 and older (Adams & McCrone, 2011; Victor, Ximenes, César de Almeida, 2012). The Barriers subscale has demonstrated association with level of education, relationship status, and level of PA engagement. Previous research demonstrated Cronbach’s alpha coefficients ranging from .95 to .97 for the total scale, .95 to .97 for the benefits scale, and .86 to .89 for the barriers scale (Conn, 1998; Sechrist et al., 1987; Victor et al.).

Cronbach alpha estimates in the present sample were .96 for the benefits scale and .86 for the barriers scale. Less than 2% of data in the present sample were missing for the barrier scale, and less than 1% were missing from the benefit scale. Inspection of missing data for the benefit scale suggested a methodological artifact, such that all missing responses were on a question about spousal support, in which participants indicated “not
The third indicator for the latent variable of outcome expectations and attitudes was enjoyment of exercise. This was assessed using the Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991), the most commonly used measure of exercise enjoyment. Respondents rated how they feel about the physical activity they have been doing using a 10-point bipolar rating scale (e.g., 1 = I feel bored, 10 = I feel interested). Select items are reverse scored. Higher total PACES scores reflected greater levels of enjoyment of physical activity. Cronbach’s alpha in present sample was high ($\alpha = .93$), with less than 1% missing data.

**Physical activity.** Self-reported physical activity was assessed using the 9-item short form of the International Physical Activity Questionnaire (IPAQ-SF; Craig et al., 2003). This measure was developed by an International Consensus Group of physical activity experts in 1998 and has since become the most widely used PA questionnaire (van Poppel, Chinapaw, Mokkink, Van Mechelen, & Terwee, 2010). This form recorded four physical activity levels over the last seven days: 1) vigorous activity, 2) moderate activity, 3) walking, and 4) sitting. Sitting data were not used in the present sample, as more than 13% of the sample had missing data for this variable. The remaining physical activity variables (vigorous activity, moderate activity, and walking) were adjusted according to author guidelines (Craig et al., 2003); namely, responses for activity less than 10 min in duration were changed to zero and any activity was truncated at 240 min/day (1680 min/week).

Participant responses for the remaining three PA variables (vigorous activity, moderate activity, and walking) were converted to min/week for each activity category,
and subsequently converted to min/week of metabolic equivalent of task (MET-min/week). MET is a physiological measure encapsulating the metabolic equivalence, or energy cost, of physical activities. It is calculated as a ratio of energy consumption during activity to the reference metabolic rate (that is, 1 MET is equivalent to sitting quietly). For example, if one engages in 30 min of aerobics that equates to 6 MET, that person expends calories at six times the metabolic rate of sitting quietly. This single session would equate to 150 MET-min. National guidelines suggest that adults achieve ≥ 500 to 1,000 MET-min/week for health maintenance, and more (≥ 2,000 MET-min/week) for greater health benefits, including weight loss (Garber et al., 2011).

The IPAQ-SF and other IPAQ instruments have demonstrated acceptable psychometric properties among adults aged 18-65. Although limitations to self-reported PA are well documented (cf. Sallis & Saelens, 2000; van Poppel et al., 2010), particularly with regards to accuracy and precision of activity estimates, there are benefits to using self-reported inventories, including cost and feasibility. The IPAQ-SF was selected for the present study as it has demonstrated psychometrics comparable or superior to other self-report inventories. The short form was preferred over the long form, as the latter has been found to be “too boring and repetitive” and cumbersome for participants (van Poppel et al, p. 596).

Two simple and rudimentary exercise questions were included for comparison with the IPAQ PA levels and other model variables. These questions asked participants to indicate how many days participants engaged in at least 30 min of exercise over two recall periods (last week and last month/30 days). These questions have demonstrated reliability, concurrent validity, and criterion validity (Milton, Bull, & Bauman, 2011) in
addition to high ease of administration. This ease was corroborated in the present sample, in which no data were missing for the last week recall period, and < 1% of data were missing from the one-month recall period.

**Data analysis**

IBM SPSS version 22 and AMOS Graphics software version 22 were used for all analyses. Data were inspected for “missingness” and other characteristics influencing fit prior to analyses. Less than 5% of the data for any given predictor variable or measure was missing, which was within the permissible range (Berkou et al., 2014). Although less than 5% of data were missing for the individual activity MET-min/week levels, 8% of the sample was missing total IPAQ MET-min/week, as it is a summary score. Full imputation maximum likelihood (FIML) estimation was used to handle missing data. This is the default estimator in Amos and is an optimal method for treating missing data in structural equation modeling because it yields consistent parameter estimates and fit indices, rather than the bias inherent in pairwise and listwise case deletion (Enders & Bandalos, 2001).

Examination of statistical assumptions underlying SEM include normality of multivariate variable distribution. Inspection of IPAQ-SF data revealed an extreme positive skew. The MET data were thus subjected to a square root transformation (after adding “1” to all scores, given the possible range of values included zero), resulting in a normal distribution for use in the SEM. Univariate analyses examined associations between demographic, health, and psychosocial variables, as well as relationships between these and the model variables (self-efficacy, self-regulation, outcome expectations), and physical activity. Of these analyses, Pearson’s correlations were
computed for continuous variables, and one-way analysis of variance (ANOVA) tested
differences in model variables and physical activity between categorical predictors (e.g.,
gender, race, ethnicity).

Exogenous (i.e., “predictor”) variables in the model were conceptualized as three
latent variables of 1) self-efficacy, 2) self-regulation, and 3) attitudes and outcome
expectations. The aforementioned indicators (from the Measures section) were loaded on
their respective latent variable. An endogenous latent variable of physical activity was
created, measured as MET-min/week (transformed), days per week of exercise, and days
per month of exercise. Physical activity was modeled as an endogenous variable,
indicating it is “caused” by the other variables in the model. Data related to demographic
and health characteristics were obtained to describe the sample; however, these constructs
were not hypothesized to affect the paths between the latent variables and PA (Conn,
1998; Conn, Hafdahl, & Mehr, 2011; McAuley et al., 2003), so they were not included in
the model.

A visual diagram of the model allowed researchers to begin analysis by ensuring
that all conceptual relationships have been represented. These diagrams used a common
language, namely: 1) oval shapes to represent latent factors, 2) rectangles to represent
measured or observed variables, 3) single-headed arrows to indicate that one variable
predicts another, and 4) double-headed arrows to indicate covariance (or correlation)
between variables (Berkout, Gross, & Young, 2014). The single-headed arrows that
point from latent variables to their indicators represent the influence of the latent variable
on the observed scores.
SEM estimated and tested the relationships among constructs. First, the measurement portion of the model is represented by the three exogenous latent variables and the respective measured variables, connected by single-headed arrows. Confirmatory factor analysis (CFA) assessed the extent to which scores on the observed variables were generated by the underlying latent constructs. Strength of regression paths (or factor loadings) from the factors to the observed variables were of primary interest.

The next step was to test the structural model, or the model that specifies how the latent variables relate to one another. The structural parameters were modeled by the arrows leading from latent variables to the outcome latent variable of PA (assessed as transformed MET-min/week, days/week of exercise during the last week, and days/week of exercise during the last month). This model specified correlations between the three exogenous latent variables derived from SCT, and all were hypothesized to have direct effects on PA. Finally, two alternative nested models were compared to the original model and to one another to best gauge fit. The model with fewer parameters (i.e., more degrees of freedom) is nested within the larger model. A chi-square difference test was used to compare two models, in which the only difference was one model specified one additional parameter to be estimated. The statistical significance of the resulting test statistic was evaluated. A significant chi-square test indicated the larger model fit the data better with more freely estimated parameters. A non-significant result indicated that the parameter in question is not necessary to explain the data; therefore, the nested model with the fixed parameter fits the data just as well as the full model.

These alternative models were derived from theory. In the first, the path between attitudes/outcome expectations and PA was restricted to test the role of this latent
variable in the model. Previous literature has demonstrated mixed findings for the effect of outcome expectations on PA; however, it is a crucial part of SCT and therefore thought to correlate with self-efficacy and self-regulation. These associations were modeled as correlations of attitudes/outcome expectations with both self-regulation and self-efficacy to retain indirect influence on PA.

One additional parameter was restricted in the next model, in which the direct path from self-efficacy to PA was eliminated (that is, set to zero). Anderson and colleagues (2006), among others, suggest that self-efficacy is an antecedent of self-regulatory strategies, thereby imparting indirect effects rather than direct effects on PA.

The primary objective of the analysis was to assess whether the model reflected underlying associations between measured and latent variables in the data. An alpha level of 0.05 was determined a priori; however, large sample sizes typically result in more power, meaning the null hypothesis may be rejected despite good fit. As such, the hypothesized model’s fit to the data must be evaluated by other means. Weston and Gore (2006) provide an overview, in which the model is evaluated by 1) significance and strength of estimated parameters, 2) variance accounted for in endogenous observed and latent variables, and 3) how well the model fits the actual data, as indicated by fit indices. Model fit can (and should) be evaluated by multiple indices as finding an exact fit is rare. The present study evaluated and interpreted model fit on two indices in addition to the $\chi^2$ value: 1) comparative fix index (CFI: Bentler, 1990), and 2) root mean square error of approximation (RMSEA; Steiger, 1990). Guidelines for acceptable fit include a nonsignificant $\chi^2$ value; as mentioned above, however, this value is susceptible to large sample size. Therefore, CFI > .90 and RMSEA < .10 were used as guidelines for
acceptable model fit to the data (Weston & Gore, 2006). These fit indices are the subject of debate among statisticians, with some arguing more stringent cutoffs of CFI > .95 and RMSEA < .06 (Weston & Gore, 2006). However, others (Marsh, Hau, & Wen, 2004) argue that since sample size affects appropriate cutoff values, smaller samples (less than $N = 500$) may suffer from inappropriate rejection when these more stringent cutoffs are used. As such, the more lenient criteria were used to evaluate model fit in the present study.
CHAPTER 3

RESULTS

Participants Characteristics

The sample consisted of 225 community-dwelling adults between the ages of 45-64 ($M = 56.86$, $SD = 5.45$) who were primarily Caucasian (88.9%), non-Hispanic (92.9%), female (66.1%), had some college education ($M = 15.90$ years, $SD = 2.76$), were married (69.8%), tended to have an overweight BMI ($M = 27.22$, $SD = 5.41$), and reported being in good health or better (86.7%). The majority of participants had more than $5,000 in savings (72.4%). Differences in demographic variables between jury duty and community respondents were tested using a series of one-way ANOVA; no differences were noted in BMI or age ($p < .05$). Chi-square test of independence did not find disproportionate representation of ethnic minority groups, Hispanic ethnicity, or gender groups (male/female) in either recruitment subsample ($p < .05$). Descriptive statistics for full demographic and model variables (nontransformed means, medians, and standard deviations) are shown in Table 1.

Physical Activity

Level of physical activity in the sample was quite variable, with a high level of total MET-min/week reported ($M = 3317.83$, $SD = 2902.37$, $Mdn = 2565.00$, range 0-13,572 MET-min/week). These data were non-normally distributed (skewness = 1.34, $SE = .17$; kurtosis = 1.58, $SE = .35$), such that a disproportionate amount of participants
Table 1
Means, Standard Deviations, and Percentages for Demographic and Health Status Variables

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>56.92</td>
<td>5.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (% female)</td>
<td>148</td>
<td>8.4</td>
<td>65.8</td>
<td></td>
</tr>
<tr>
<td>Race (% Non-Caucasian)</td>
<td>19</td>
<td></td>
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<tr>
<td>Caucasian</td>
<td>200</td>
<td></td>
<td>88.9</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>1</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Asian American</td>
<td>4</td>
<td>1.8</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Multiracial</td>
<td>12</td>
<td>5.3</td>
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<tr>
<td>Ethnicity (% Hispanic)</td>
<td>13</td>
<td>5.8</td>
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<tr>
<td>Relationship Status (% partnered)</td>
<td>161</td>
<td>71.6</td>
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<tr>
<td>Single</td>
<td>14</td>
<td>6.2</td>
<td></td>
<td></td>
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<tr>
<td>Married/domestic partnership</td>
<td>157</td>
<td>69.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohabitating</td>
<td>4</td>
<td>1.8</td>
<td></td>
<td></td>
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<tr>
<td>Divorced/separated</td>
<td>43</td>
<td>19.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>7</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (% ≤ High school)</td>
<td>15.90</td>
<td>2.76</td>
<td>40</td>
<td>17.8</td>
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<tr>
<td>Annual Income (% &lt; $64,000)</td>
<td>113</td>
<td>50.2</td>
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<tr>
<td>≤ $25,550</td>
<td>36</td>
<td>16.0</td>
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<tr>
<td>25,501-64,000</td>
<td>77</td>
<td>34.2</td>
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<tr>
<td>&gt; $64,001</td>
<td>108</td>
<td>48.0</td>
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<tr>
<td>Assets (% &lt; $5,000 in savings)</td>
<td>60</td>
<td>26.7</td>
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<tr>
<td><strong>Health factors</strong></td>
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<tr>
<td>BMI (% obese)</td>
<td>27.22</td>
<td>5.41</td>
<td>51</td>
<td>22.7</td>
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<tr>
<td>Normal (18.0-24.9)</td>
<td>82</td>
<td>36.4</td>
<td></td>
<td></td>
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<tr>
<td>Overweight (25.0-29.9)</td>
<td>80</td>
<td>35.6</td>
<td></td>
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<tr>
<td>Obese class 1 (30.0-34.9)</td>
<td>35</td>
<td>15.6</td>
<td></td>
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<tr>
<td>Obese class 2 (35.0-39.9)</td>
<td>9</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese class 3 (≥ 40.0)</td>
<td>7</td>
<td>3.1</td>
<td></td>
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<tr>
<td>Self-Rated health (% good or better)</td>
<td>2.36</td>
<td>0.98</td>
<td>195</td>
<td>86.7</td>
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<tr>
<td>Excellent</td>
<td>43</td>
<td>19.1</td>
<td></td>
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<tr>
<td>Very good</td>
<td>91</td>
<td>40.4</td>
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<tr>
<td>Good</td>
<td>61</td>
<td>27.1</td>
<td></td>
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<tr>
<td>Fair</td>
<td>26</td>
<td>11.6</td>
<td></td>
<td></td>
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<tr>
<td>Poor</td>
<td>4</td>
<td>1.8</td>
<td></td>
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<tr>
<td>PHQ-2 (% depressed)</td>
<td>0.78</td>
<td>1.20</td>
<td>14</td>
<td>6.2</td>
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<tr>
<td>PHQ-2 (BPI)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Average</td>
<td>2.26</td>
<td>2.13</td>
<td></td>
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<tr>
<td>Worst</td>
<td>3.43</td>
<td>2.93</td>
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<tr>
<td>Friends/family physically active (% yes)</td>
<td>191</td>
<td>84.9</td>
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reported no or low MET-min/week, and the remainder of participants reported MET-min/week across a wide upper range. When three participants with outlying total MET-min/week (greater than three standard deviations above the mean) were removed, average total MET-min/week were still high and variable ($M = 3164.69$, $SD = 2646.72$, range 0-11,862.00 MET-min/week). Removing the top and bottom 5% of cases yielded a trimmed $M = 3057.09$ MET-min/week. Overall, participants reportedly spent 185.11 min/week ($SD = 210.23$, $Mdn = 120.00$) in vigorous PA, 211.59 min/week ($SD = 295.59$, $Mdn = 90.00$) in moderate PA, and 314.31 min/week ($SD = 314.31$, $Mdn = 180.00$) engaging in walking. When walking and moderate PA were combined, participants reportedly spent an average of 515.72 min/week ($SD = 523.02$, $Mdn = 325.00$) in walking and/or moderate PA. More than half (56%) of the sample met vigorous activity guidelines (at least 75 min/week) and 44.4% of the sample met moderate activity guidelines (at least 150 min/week of moderate PA, excluding walking). When walking was included as moderate PA, 68.9% of the sample reported meeting guidelines for at least 150 min/week, and 78.7% of the sample met either moderate/walking or vigorous PA guidelines. Only 4% of the sample reported no vigorous, moderate, or walking activity during the previous week. The majority of the sample reported that at least one close friend or family member exercised regularly (85.3%). See Table 2 for means and standard deviations of all indicator variables used in SEM.

The more rudimentary exercise questions (“In the past week/In the past month, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?”) showed similar variability of PA levels among participants, albeit with more modest reporting of average days per week ($M =$
Table 2  
*Descriptive Statistics of the Measured Variables Used in the Structural Equation Model*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$M$</th>
<th>$Mdn$</th>
<th>$SD$</th>
<th>Range</th>
<th>$n$</th>
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<tr>
<td><strong>Physical Activity</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IPAQ Met-min/week</td>
<td>3317.83</td>
<td>2565.00</td>
<td>2902.37</td>
<td>0-13572.00</td>
<td>197</td>
</tr>
<tr>
<td>Vig PA min/week</td>
<td>185.11</td>
<td>120.00</td>
<td>210.23</td>
<td>0-1080.00</td>
<td>212</td>
</tr>
<tr>
<td>Mod PA min/week</td>
<td>211.59</td>
<td>90.00</td>
<td>295.59</td>
<td>0-1260.00</td>
<td>211</td>
</tr>
<tr>
<td>Walking min/week</td>
<td>314.31</td>
<td>180.00</td>
<td>349.01</td>
<td>0-1260.00</td>
<td>211</td>
</tr>
<tr>
<td>Milton et al. (2011)</td>
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<td></td>
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</tr>
<tr>
<td>Days/week</td>
<td>3.27</td>
<td>3.00</td>
<td>2.12</td>
<td>0-7</td>
<td>225</td>
</tr>
<tr>
<td>Days/month</td>
<td>13.87</td>
<td>12.00</td>
<td>9.01</td>
<td>0-31</td>
<td>224</td>
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<tr>
<td><strong>Self-Efficacy</strong></td>
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<tr>
<td>Bray SE</td>
<td>84.51</td>
<td>100.00</td>
<td>25.21</td>
<td>0-100</td>
<td>225</td>
</tr>
<tr>
<td>EXSE</td>
<td>24.03</td>
<td>100.00</td>
<td>25.23</td>
<td>0-100</td>
<td>225</td>
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<tr>
<td>BARSE</td>
<td>62.19</td>
<td>64.55</td>
<td>24.79</td>
<td>3.64-100.00</td>
<td>225</td>
</tr>
<tr>
<td><strong>Self-Regulation</strong></td>
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<tr>
<td>Goal</td>
<td>15.64</td>
<td>15.00</td>
<td>6.17</td>
<td>6.00-30.00</td>
<td>225</td>
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<tr>
<td>Priority</td>
<td>13.96</td>
<td>14.00</td>
<td>4.39</td>
<td>4.00-20.00</td>
<td>225</td>
</tr>
<tr>
<td>Planning</td>
<td>9.55</td>
<td>9.00</td>
<td>4.59</td>
<td>4.00-20.00</td>
<td>225</td>
</tr>
<tr>
<td><strong>Attitudes &amp; Outcome Expectations</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Benefit</td>
<td>96.00</td>
<td>97.00</td>
<td>13.30</td>
<td>42.00-122.00</td>
<td>225</td>
</tr>
<tr>
<td>Barrier</td>
<td>44.06</td>
<td>44.00</td>
<td>6.28</td>
<td>27.00-56.00</td>
<td>223</td>
</tr>
<tr>
<td>PACES</td>
<td>137.33</td>
<td>145.00</td>
<td>28.69</td>
<td>55.05-180.00</td>
<td>225</td>
</tr>
</tbody>
</table>

$3.27, SD = 2.12, \text{ range } 0-7)$ and days during the past month ($M = 13.87, SD = 9.01, \text{ range } 0-31$) reportedly spent exercising. A majority of participants ($61.9\%$) reported exercising at least three days during the last week. This criterion is consistent with the physical activity guidelines of the American College of Sports Medicine and the American Heart Association (Haskell et al., 2007). When more stringent criterion of five days over the past week was applied, only $31.7\%$ of the sample reported meeting such guidelines. A small proportion of the sample ($13.3\%$) reported no exercise of at least 30 min in duration.
over the previous week. When participants were prompted to recall days of exercise over
the last month, more than half (56.1%) reported exercising at least three times per week
on average (i.e., 12 or more times during the previous month), and 34.4% reported
exercising on average five times per week (i.e., 20 or more times during the previous
month). Only 5.8% of the sample was completely sedentary, reporting no days of
exercise during the past month.

Univariate analyses examined the relationship between demographic and physical
activity on the IPAQ and found that physical activity (measured by MET-min/week,
min/week of vigorous PA, min/week of moderate PA, and min/week of walking) was not
correlated with age or years of education. These measures of physical activity did not
differ by gender, racial minority status, or Hispanic ethnicity (note: for all non-significant
one-way ANOVA tests discussed herein, $p > .05$, $R^2 < .01$). However, participants who
reported having more than $5,000 in savings reported greater MET-min/week [$F(1, 194) = 5.49$, $p = .02$, $R^2 = .03$]. See Table 3 for intercorrelations of demographic and model
variables.

When the simplified exercise frequency variables were analyzed, results were
similar to the IPAQ in that neither days/week nor days/month spent exercising was
correlated with age or gender. However, more education was associated with more days
spent exercising in the past week and month. Having more than $5,000 in savings was
associated with more frequent exercise during the past week [$F(1, 221) = 14.70$, $p < .001$,
$R^2 = .06$] and month [$F(1, 220) = 15.09$, $p < .001$, $R^2 = .06$].

Univariate analyses of health-related variables indicated that better self-rated
health and less loneliness were associated with more MET-min/week reported on the
Table 3

Intercorrelations of Measured Variables Used in the Structural Equation Model of Physical Activity

| Variable | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. Age (yrs) | .07 |
| 2. Edu (yrs)  | .09 | .17 |
| 3. Dep/wk     | .06 | .17 | .90 |
| 4. Dep/mnth   | -.01| .09 | .52 | .52 |
| 5. METS       | -.01| .07 | .51 | .49 | .79 |
| 6. VigPA/min/wk| -.01| .07 | .51 | .49 | .79 |
| 7. ModPA/min/wk| .05 | .02 | .31 | .30 | .80 | .51 |
| 8. Walk/min/wk| -.01| .02 | .25 | .28 | .63 | .13 | .39 |
| 10. EXSE      | .02 | .15 | .45 | .48 | .31 | .29 | .17 | .15 | .43 |
| 11. BARSE     | .07 | .23 | .51 | .59 | .40 | .37 | .26 | .17 | .47 | .56 |
| 12. Goal      | -.03| .14 | .45 | .49 | .41 | .32 | .24 | .21 | .28 | .39 | .50 |
| 13. Priority  | .17 | .02 | .56 | .57 | .36 | .34 | .14 | .10 | .21 | .50 | .49 | .37 |
| 14. Planning  | .12 | .10 | .45 | .45 | .34 | .38 | .15 | .04 | .25 | .41 | .40 | .60 | .50 |
| 15. Benefit   | -.01| .18 | .40 | .44 | .42 | .39 | .29 | .15 | .37 | .37 | .48 | .55 | .44 | .49 |
| 16. Barrier   | .11 | .27 | .42 | .45 | .30 | .29 | .14 | .06 | .40 | .40 | .53 | .39 | .57 | .47 |
| 17. PACES     | .08 | .19 | .51 | .55 | .41 | .42 | .26 | .14 | .48 | .48 | .53 | .43 | .47 | .45 | .59 | .56 |
| 18. BMI       | .01 | -.10 | -.35 | -.38 | -.11 | -.24 | -.01 | .10 | -.41 | -.18 | -.20 | -.08 | -.21 | -.17 | -.23 | -.30 | -.27 |
| 19. Health    | .05 | -.18 | -.44 | -.47 | -.82 | -.82 | -.39 | -.12 | -.54 | -.60 | -.02 | -.25 | -.36 | -.35 | -.41 | -.40 | -.45 | -.52 |
| 20. BPIavg    | .07 | -.08 | -.12 | -.13 | -.04 | -.05 | -.03 | -.06 | -.53 | -.20 | -.22 | -.01 | -.05 | -.06 | -.16 | -.19 | -.19 | -.22 | -.43 |
| 21. BPIworst  | .05 | -.06 | -.11 | -.15 | -.05 | -.06 | -.03 | -.29 | -.17 | -.16 | -.01 | -.06 | -.04 | -.15 | -.14 | -.13 | -.15 | -.44 | .89 |
| 22. PHQ-2     | .01 | -.18 | -.25 | -.30 | -.10 | -.12 | -.03 | -.12 | -.51 | -.25 | -.12 | -.23 | -.10 | -.20 | -.10 | -.30 | -.35 | -.44 | .16 |
| 23. ULS       | .12 | -.14 | -.19 | -.20 | -.14 | -.15 | -.07 | -.09 | -.23 | -.12 | -.21 | -.10 | -.05 | -.06 | -.11 | -.28 | -.17 | .11 | .26 | .14 | .08 | .51 |
IPAQ. Contrary to hypotheses, MET-min/week was not correlated with BMI, average pain, or frequency/severity of depressive symptoms.

In contrast with the IPAQ MET-min/week data, higher BMI was associated with fewer days during the past week spent exercising and fewer days during the past month spent exercising. Elevated depressive symptoms were associated with fewer days during the past week and past month spent exercising. Greater loneliness was also correlated with fewer days of exercise during the past week and month. Similar to the IPAQ findings, better self-rated health was associated with more days of exercise during the past week and past month. Neither age nor gender was associated with either of these PA outcome variables. Individuals who were Caucasian \([F(1, 223) = 4.39, p = .01, R^2 = .01]\) and non-Hispanic \([F(1, 220) = 6.66, p = .01, R^2 < .01]\) reported more days of exercise during the past week, but did not differ from their racial and ethnic counterparts in days of exercise during the past month.

**Model Variables**

**Self-efficacy.** Task-related self-efficacy (Bray SE), exercise self-efficacy (EXSE), and barrier self-efficacy (BARSE) were all high in the sample and were all positively correlated with MET-min/week, days/week spent exercising, and days/month spent exercising. Individuals with over $5,000 in savings, higher education, lower BMI, better self-rated health, and fewer depressive symptoms endorsed higher levels of self-efficacy across all three measures. Those participants who reported that a close friend or family member regularly exercises reported high levels of all three types of self-efficacy; however, those who were married only differed with regard to higher levels of task self-efficacy, and did not differ from their non-married counterparts in exercise or barrier self-
efficacy. Older age in the sample was associated with lower task-related self-efficacy but not associated with self-efficacy for exercise or barriers. Non-Hispanic individuals reported greater task-related self-efficacy than their Hispanic counterparts, but the two ethnic groups did not differ on exercise or barrier self-efficacy. Loneliness was not associated with exercise self-efficacy but was inversely associated with task-related and barrier self-efficacy.

**Self-regulation.** Use of self-regulatory skills such as goal-setting, prioritizing exercise, and planning for physical activity, were all positively correlated with MET-min/week, days/week spent exercising, and days/month spent exercising. Increased age was associated with placing a greater priority on exercise, but was not associated with the use of goal-setting or planning strategies. Individuals with over $5,000 in savings used all three self-regulatory strategies to a greater degree. Individuals with higher education reported slightly greater goal-setting, but education was not associated with prioritization or planning of exercise. Better self-reported health was associated with greater use of all three skills. Those with heavier BMI reported less prioritization and planning, but BMI was not associated with use of goal-setting. Neither marital status, loneliness, nor having a close friend or family member regularly exercise were associated with any self-regulatory variables. Elevated symptoms of depression was associated with greater prioritization of exercise but not related to goal-setting or planning for exercise. There was no association between self-regulatory skills and demographic factors of gender, race, and Hispanic ethnicity.

**Outcome expectations.** The final latent variable was comprised of perceived enjoyment, perceived benefits, and perceived barriers of exercise. More enjoyment,
greater benefits, and fewer barriers were associated with greater MET-min/week, days/week spent exercising, and days/month spent exercising in the sample. Participants with lower BMI, better self-rated health, fewer symptoms of depression reported more enjoyment, greater benefits, and fewer barriers associated with physical activity. Greater loneliness was associated with less enjoyment and more barriers, but was not related to perceived benefits of exercise. Individuals with over $5,000 in savings, as well as those with higher education, reported greater enjoyment and benefits and fewer barrier than their counterparts. Those who had a close friend or family member who regularly exercised reported greater enjoyment and more perceived benefits, but this was not associated with differences in perceived barriers. None of the demographic variables of age, gender, race, Hispanic ethnicity, nor marital status were associated with differences in outcome expectations.

**Measurement Model**

The initial test of the correlated latent-factor measurement model provided a questionable fit to the data ($\chi^2 = 93.36$, df = 24, $p < .001$, CFI = .92, TLI = .84, RMSEA = .11, 90% CI = .09-.14). Modification indices were reviewed to consider exploratory model adjustments to improve fit, as these can pinpoint areas of model misfit (Byrne, 2013). These results suggested that correlated error terms for selected self-regulation measures would reduce the value of the $\chi^2$ test statistic; however, these exploratory changes did not significantly improve model fit ($\chi^2 = 69.15$, df = 22, $p < .001$, CFI = .94, TLI = .88, RMSEA = .10, 90% CI = .07-.12). Modification indices are sample-specific and as such may capitalize on chance findings if not supported by theoretical or methodological rationale and replicated with cross-validation. Given that modifications
suggested were inconsistently applied to selected self-regulation measures and did not dramatically improve fit, they were discarded. The original measurement model was used to test the structural model (see Figure 1).

**Structural Model**

Although the model yielded a statistically significant chi-square test ($\chi^2 = 141.13$, df = 48, $p < .001$), the fit indices that are not susceptible to large sample size indicated adequate fit as determined by the less stringent cut points determined a priori (CFI = .94, TLI = .90, RMSEA = .09, 90% CI = .08-.11; Weston & Gore, 2006). Both self-regulation (CR = 2.32, $SE = .18$, $p = .02$; threshold is $CR_{\text{absolute}} = 1.96$) and self-efficacy (CR = 2.36, $SE = .19$, $p = .02$) imparted significant direct effects on the latent variable of physical activity. Contrary to the hypothesized model, the latent variable of attitudes and outcome expectations did not have a statistically significant direct effect on physical activity (CR = -1.04, $p = .30$). See Figure 2 for standardized path estimates and Table 4 for a summary of this and subsequent model fit statistics. The hypothesized model accounted for 63% of the variance in the latent variable of physical activity.

Next, a nested model was tested, in which the latent variable of attitudes and outcome expectations was hypothesized to have an indirect effect on PA through correlations with self-efficacy and self-regulation (see Figure 3). As before, the chi-square test was rejected ($\chi^2 = 142.73$, df = 49, $p < .001$). Removing the direct path to create a more parsimonious model did not significantly alter model fit (58% of PA...
Figure 1. Measurement model specifying three correlated latent exogenous variables, with factor loadings and squared multiple correlations of indicator variables.
Figure 2. Structural equation model specifying three correlated latent variables with direct effects on physical activity, with factor loadings and squared multiple correlations.
<table>
<thead>
<tr>
<th>Model Fit Indices</th>
<th>df</th>
<th>$\chi^2$</th>
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<td>48</td>
<td>141.13</td>
<td>&lt; .001</td>
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* $\chi^2$, chi-square goodness of fit test
* CFI, comparative fit index
* TLI, Tucker Lewis index
* RMSEA, root mean square error of approximation
* 90% CI, confidence interval for the root mean square error of approximation
* $R^2$, squared multiple correlation in physical activity (percentage of variance accounted for by the model)
* $\chi^2$ diff test of nested models (difference of df = 1)
† standardized regression weights
‡ standardized total effects
Figure 3. Nested model specifying indirect effects of attitudes and outcome expectations on PA, via correlation with self-efficacy and self-regulation.
explained; chi-square difference test: $\chi^2 = 1.60$, df = 1, $p = .21$) and had fit indices comparable to the original model (CFI = .94, TLI = .90, RMSEA = .09, 90% CI = .08-.11), suggesting the parsimonious model offered a better fit to the data.

Finally, both the latent variable of self-efficacy and the latent variable of attitudes and outcome expectations were modeled as having indirect, rather than direct, on PA via self-regulation. This nested model (see Figure 4) fit the data significantly worse than the previous model ($\chi^2 = 149.24$, df = 50, $p < .001$, chi-square difference test: $\chi^2 = 6.51$, df = 1, $p = .01$). However, fit indices remained comparable to the previous two models (CFI = .93, TLI = .90, RMSEA = .09, 90% CI = .08-.11), with 61% of PA explained by this model.
Figure 4. Nested model specifying indirect effects of self-regulation and attitudes and outcome expectations on PA, via self-regulation.
CHAPTER 4
DISCUSSION

The present study used structural equation modeling to better understand the correlates of physical activity among 225 adults aged 45 to 64 years. To achieve a more thorough understanding of the processes associated with physical activity, the model used three empirically supported constructs—self-efficacy, self-regulation, and attitudes and outcome expectations. These three latent variables were highly correlated with one another. Univariate analyses of the manifest variables suggested that self-efficacy, self-regulatory strategies, and attitudes and outcome expectations were all significantly associated with physical activity levels reported by participants. The hypothesized model provided an adequate fit to the data and explained a large amount (63%) of the variance in physical activity assessed as MET-min/week, days per week of exercise, and days per month of exercise. The best fitting model was one in which attitudes and outcome expectations exerted an indirect, rather than direct, effect on PA through self-efficacy and self-regulation.

These findings extend previous research that has demonstrated mixed evidence for the associations of these constructs with PA. Some of the differences in the literature may be due to differences between samples. Notably, much of the existing literature base utilizes convenience samples of adults who are enrolled in an exercise intervention. Furthermore, few studies have looked at middle-aged adults; instead favoring young adult
(college-aged) or older adult (65+) samples. The present study differs in the use of a community-dwelling sample of middle aged adults. As seen in much of the literature, self-regulation contributed significantly to explaining variance in PA and was important for model fit. Self-efficacy, the most studied of the constructs used herein, had a significant influence on PA in this sample. Of note, model fit worsened when the direct effect of self-efficacy on PA was removed in favor of an indirect path through self-regulation, as some previous literature has suggested. The construct of outcome expectations have been used inconsistently in models of correlates and determinants of PA, with mixed results. The present study found that this latent variable helped explain a portion of the variance in PA, but did so indirectly through correlations with self-efficacy and self-regulation. These findings fit with the strong literature base applying social cognitive theory to physical activity (Anderson et al., 2006; White, Wójcicki, & McAuley, 2012). However, the questionable model fit and the remaining unexplained variance in PA (37%), leave some questions for discussion and future research.

Self-efficacy was high in the present sample, particularly among individuals with socioeconomic resources (over $5,000 in savings, higher education levels) and better health (lower BMI, better self-rated health, and fewer depressive symptoms). Those with social models (having a close friend or family member who regularly exercises), which can be construed as social support for exercise, reported higher levels of self-efficacy. This is consistent with previous literature suggesting that social support indirectly increases PA through self-efficacy (Anderson et al., 2006). Contrary to previous research (Tucker et al., 2011), self-efficacy for task, exercise, and barriers did not differ by race or gender.
Exploratory analyses of the relationship between age and self-efficacy found that age did not covary with barrier self-efficacy or self-efficacy for exercise. However, age had a small but statistically significant inverse relationship with one’s self-efficacy to exercise over subsequent weeks. Although the existing literature suggests that self-efficacy is uniformly lower in older samples (Ayotte, Margrett, & Hicks-Patrick, 2010), McAuley and colleagues (2006) found that older adults who exercised regularly reported higher self-efficacy than non-exercisers. This effect was particularly notable in older women (McAuley et al.). These mixed findings are often a result of cross-sectional data, which limits conclusions about the temporal or directional relationship between age, self-efficacy, and PA. The findings in previous research suggest that increased age is associated with lower self-efficacy, which may in turn predict lower levels of PA. However, it is also plausible that individuals who exercise regularly report higher self-efficacy that is generated from previous success (mastery experiences) with regular exercise.

Although self-efficacy is touted as a consistent predictor of PA adoption and maintenance, some research suggests that self-efficacy is more important in increasing self-regulatory strategies, thereby imparting indirect effects rather than direct effects on PA (Anderson et al., 2006). The present sample reported regular use of self-regulatory behaviors for physical activity, including goal-setting, prioritizing, and planning. Greater use of these skills as captured by the three observed variables was correlated with more frequent physical activity. Furthermore, the latent variable of self-regulation exerted a consistent and direct effect on physical activity in the original structural model and nested models. The latent variable of self-regulation was highly correlated with both self-
efficacy and outcome expectations, and these relationships were perhaps better explained by alternative analyses modeling indirect effects of outcome expectations on PA via self-regulation. Both theory (Bandura, 1977) and interventional research (Anderson et al., 2006) have underscored the importance of self-regulation in changing health behavior, typically demonstrating that self-efficacy has little effect on PA independent of self-regulatory behaviors (Anderson et al., 2006). However, the present study found that the best fitting model was one in which both self-efficacy and self-regulation independently exerted direct effects on PA, as well as correlation with one another. These increasingly consistent findings support the ubiquity of self-regulation across theories of health behavior change; however, this has not always been translated into intervention. For example, the U.S. government initiative Healthy People 2020 (USDHHS, 2016) cites self-efficacy, attitudes, and outcome expectations as facilitators of physical activity, but does not specify self-regulatory strategies. The findings of the present study dovetail with previous literature to highlight the need to include these behavioral strategies in exercise promotion and maintenance interventions.

Finally, attitudes and outcome expectations were represented by manifest variables of benefit, barriers, and enjoyment associated with physical activity. In univariate analyses, participants with better health (lower BMI, better self-rated health, fewer symptoms of depression) and more socioeconomic resources (over $5,000 in savings, higher education) reported more enjoyment, greater benefits, and fewer barriers associated with physical activity. None of the demographic variables of age, gender, race, Hispanic ethnicity, nor marital status were associated with differences in outcome expectations. The latent variable of attitudes and outcome expectations was highly
correlated with self-efficacy and self-regulatory strategies. However, the latent variable of outcome expectations and attitudes did not directly influence physical activity; rather, it contributed indirectly to explained variance in PA via self-regulation and self-efficacy. This finding fits with Resnick’s (2001) conclusion that more positive outcome expectations were associated with increased levels of exercise via indirect influences on self-efficacy and self-regulation.

Participants self-reported much higher rates and frequency of physically active than expected based on review of the literature. Over half (56%) of the sample reported at least 75 min/week of vigorous physical activity (52.7% of women and 63.2% of men). While this is much higher than reports of the national average, these data are comparable to CDC data from the state of Colorado, in which 61.8% of adults achieved physical activity guidelines of 150 min/week of MVPA and 40.7% exceeded guidelines with 300 min/week or more of aerobic activity. Only 16.5% of adults in the state reported no physical activity during the past month (CDC, 2014b). Furthermore, Tucker and colleagues (2011) found that 62% of U.S. adults achieved the PA guidelines (75 min/week of vigorous or 150 min/week of moderate PA) based on self-report of leisure, transportation, and household activities in the NHANES study. This in stark contrast to the 40.5% physical inactivity prevalence rate demonstrated by Hallal and colleagues (2012) in their review of nationally representative physical activity data. Finally, Tucker and colleagues found that only 9.5% of men and 7.0% of women in a nationally representative sample achieved the recommended levels of PA when assessed via accelerometry, providing further evidence of the limited consensus on true national PA levels. Since there were no objective PA data obtained in the current study, it is unknown
if the PA levels reported by participants in the sample were accurate or represented over-reporting of actual activity. The present sample may have been prone to selection bias, in which a subset of adults who frequently exercise, or who feel positively about exercise, were disproportionately sampled as self-selected volunteers. In that case the sample may not be representative of the general population of adults aged 45-64 years old. PA levels reported herein may also be subject to a response bias. Self-reported PA in the present study may have been biased, or inaccurate, such that there was systematic error in how respondents overestimated true levels of activity. It is less likely that the present findings were influenced by random error, given the large sample size. The IPAQ is a widely use measure with demonstrated psychometrics and feasibility; however, there is known over-reporting on this measure, and no adjustment factor has been determined to account for this (Lee, Macfarlane, Lam, & Stewart, 2011).

The present study represents a preliminary foray into understanding multiple modifiable determinants of physical activity in middle-aged adults. A methodological strength is the use of structural equation modeling, which allowed for a clear conceptualization of the multivariate relationships under study. The majority of previous research has only included one, or perhaps two, determinants of physical activity, whereas this study simultaneously modeled three empirically-derived latent variables. Additionally, SEM explicitly estimates the error variance of measured variables, the latter of which traditional multivariate techniques ignores. Measurement, particularly of psychological constructs, can be prone to error. By including this measurement error into the model, SEM derives unbiased estimates of the relationships between latent constructs. This study used well-validated and frequently used measures drawn from review of the
empirical literature; however, not all had demonstrated psychometrics in midlife samples. This is likely related to the lack of representation of middle-aged samples in the literature, particularly in the absence of an intervention trial. The measurement model was a questionable fit to the data, but examination of bivariate correlation suggests that indicator variables in the same latent variable were highly associated.

Another strength of the study was the focus on community-dwelling middle-aged adults. The lack of representation of middle-aged participants in the physical activity literature is problematic, as this age group is more likely to be sedentary and less likely to meet PA guidelines than younger adults (National Center for Health Statistics, 2015). Furthermore, it is crucial to understand PA as this large population segment is aging, as aging confers an increased risk of chronic diseases associated with physical inactivity. Physical activity levels at midlife are associated with survival to age 70 and older in women, even after adjusting for demographic (i.e., age, education, marital status) and relevant medical covariates (e.g., family history of cardiovascular disease, health behaviors; Sun et al., 2010). Such an understanding of modifiable targets could be used to design and implement more effective exercise interventions for this understudied segment of the population.

The present study did not find much covariance between demographic characteristics and manifest variables. Given the particular emphasis on age in the present study, it is worth noting that there were no associations found between age and any of the manifest physical activity variables. Older age in the sample was associated with lower task-related self-efficacy but not associated with self-efficacy for exercise or barriers. Increased age was associated with placing a greater priority on exercise, but was
not associated with the use of goal-setting or planning strategies. There was no correlation between age and expectations of benefits or barriers of exercise, or age and enjoyment of exercise. Consistent with the recommendation by Williams (2010), outcome expectations was conceptualized broadly and operationalized as perceived benefits (e.g., health benefits), perceived barriers, and affective experience of physical activity. However, other researchers (Gellert, Ziegelmann, & Schwarzer, 2011) have demonstrated that affective versus health-related outcome expectancies were more powerful in predicting PA in older samples (i.e., those aged 60 and older). There is a dearth of guidance on this topic in middle-aged adults. However, it may stand to reason that individuals in midlife place more emphasis on distal health outcomes than older adults, or at least equally weigh the immediate affective experience and more distal outcomes.

Although the present study used a truncated stage of life (i.e., midlife), a spread of 20 years was represented in the sample, which may have captured any variability present between age, self-efficacy, and PA. Contrary to other developmental stages, though, a 20 year spread at midlife may not capture the same variability as earlier life stages (e.g., childhood, adolescence, young adulthood), in which rapid change occurs over relatively shorter time. Despite a two decade age range, from a developmental stage perspective, the present sample was largely in the same “season of life” (Levinson, 1977). Levinson theorized that middle adulthood is a stage that juxtaposes stability and commitment to current tasks (e.g., family, career) with transition as one makes choices about the future (e.g., planning for retirement, thinking about leaving a legacy). For example, levels of self-efficacy were reportedly high throughout this sample, which may be a reflection of
true perceived capabilities in this sample (and the greater population). Perhaps midlife represents a time where a history of successful experiences combine with relative stability of midlife to strengthen self-efficacy beliefs. It is also possible that the uniformly high levels of self-efficacy reported in this sample limited the ability to explain variability in this construct. This could reflect a measurement issue or response bias in the sample (as evidenced by very high internal consistency values for all three self-efficacy measures). Future research is needed to disentangle these processes in midlife.

Limitations

Limitations of the present study must be acknowledged. First, physical activity data was self-reported for reasons of acceptability, cost, and practicality. Although the IPAQ-SF is widely used and recommended, a recent systematic review of the measure found it tends to overestimate the amount of PA compared to objective devices, with high variability for vigorous activity, moderate activity, and walking (Lee et al., 2011). The present sample reported high levels of activity engagement across domains and intensities that exceeded national guidelines for activity. Although Colorado touts a healthy population that is more physically active than the average U.S. adult, the present sample exercised at two-to-three times the level of MET-min/week national guidelines. Skepticism of these results is warranted, as retrospective self-reports may be less precise than objectively measured physical activity for reasons of interpretation, recall distortions, and social desirability bias. A comprehensive review found that self-reported physical activity differed from accelerometer data by an average of 44% across studies, with female-only samples tending to over-report PA 138% more than accelerometry suggested (Prince et al., 2008). Furthermore, Prince and colleagues found that this
discrepancy increased with higher levels of physical intensity. Misinterpretation of survey questions may also lead to biased results. Seminal work by Baranowski (1988) asserted that recalling physical activity is a complex cognitive task, which requires respondents to understand ambiguous terms such as “physical activity,” “leisure-time,” and “moderate-intensity.” Little has changed with regards to the cognitive demands of questionnaires such as the IPAQ.

Few studies have explicitly examined social desirability and physical activity reports, and those that have examined these factors in children (Klesges et al., 2004) and young adults (Motl, McAuley, & DiStefano, 2005) only. Contrary to what one might assume, these studies demonstrated minimal evidence of an influence of social desirability on self-reported physical activity in these populations. In fact, Motl and colleagues argued that social desirability may be a bigger concern with interview-administered instruments, given the privacy of self-report. Furthermore, social desirability bias is more likely in children and adolescents, as it decreases as a function of age (Warnecke et al., 1997). Some argue that vigorous PA might be the least susceptible to over-reporting or social desirability bias, given the relatively low rates in the population (Tucker et al., 2011). However, issues of interpretation of questions may account for the questionably high levels of vigorous PA reported by participants in the current study. A majority of participants (56%) in the current study reportedly engaged in at least 75 min/week of vigorous physical activity. Tucker and colleagues found that only 10% of adults met the physical activity guidelines according to the gold standard of accelerometry; however, the authors argued that accelerometry may in fact underestimate true physical activity levels because of anthropomorphic differences in participants of
older age and with higher BMI. Clearly, a better consensus on the best measurement of physical activity is warranted, particularly one that considers multiple factors such as cost, feasibility, and precision.

Second, the present study utilized a cross-sectional design, limiting any conclusions about a temporal or causal relationship between study constructs. While this is the case for many investigations in the literature, longitudinal observation and experimental studies are needed to understand determinants and causal variables (Bauman et al., 2012). On a related note, the present study utilized a recursive model; that is, the direction of cause flowed from one direction only. Recursive models are easier to estimate and are typical of what is represented in the literature. However, it is possible or even probable that the underlying latent variables and PA behavior function in a nonrecursive fashion of reciprocal determinism; that is, one in which the causal relationships are bi-directional. In that sense, the present model may better be conceptualized as one that allows for reciprocal feedback effects (Bryne, 2013). For example, research has demonstrated a causal relationship between predictors (e.g. between self-efficacy and outcome expectations, and vice versa; Williams, 2010).

Furthermore, Bandura’s (1977) SCT proposed that self-efficacy is a consequence of mastery experiences, in which self-efficacy increases with successful performance of a target behavior. The PA literature has traditionally focused on increases in self-efficacy as the driving force behind increased PA; however, it stands to reason that increased PA behavior could reciprocally increase self-efficacy. A longitudinal design would enhance the current study, allowing for modeling of temporal and causal relations. This would be further facilitated by using a more precise and accurate physical activity measurement,
rather than relying exclusively on retrospective self-report of PA (e.g., accelerometer, Fitbit).

Third, the present study is limited in generalizability and would benefit from replication in other samples. This manifests in two ways—both statistically, with respect to cross-validation of the SEM, as well as methodologically, with regards to the external validity of the present sample characterizes and procedure. Cross-validation of the model in another sample would strengthen validity of the best-fitting model presented herein. The present sample size precluded cross-validation of the modified models in independent samples from the sample population. Without cross-validation, the generalizability of the model to other samples and to the general population is limited as model specification is a process driven by the data at hand. Regarding sample characteristics and ecological validity, methodological considerations were enacted in the attempt to recruit a heterogeneous sample; namely, specifying minimal exclusion criteria for participation and recruiting participants at jury duty. However, all respondents volunteered for the study and therefore may be different than non-responders in certain characteristics (e.g., demographic factors, health status, PA behavior, attitudes, etc.). For example, participants who exercise more regularly may have self-selected into this study, which may account for the higher-than-expected levels of PA in the sample. Furthermore, all data were collected during the spring and summer in the Pikes Peak region of Colorado, which limits generalizability to other geographic regions, climates, and seasons. The socioecological model of physical activity highlights the importance of community and environmental factors in physical activity, which has been supported by a systematic review finding a cross-sectional association between neighborhood
walkability and physical activity (McCormack & Shiell, 2011). A majority of the PA literature, including the present study, has involved middle-class, mostly Caucasian adults living in urban or suburban locales. The present sample was more likely to be White and female than the general US population (U.S. Census Bureau, 2015). Different populations, including older adults, those in rural locales, specific ethnic and racial groups, individuals of low socioeconomic status, and those with varying health statuses may have unique barriers or facilitators of PA. Furthermore, it is unknown if the underlying latent constructs identified in the present study relate to PA in the same way in other groups. Prior research presents a strong argument for using theories to guide behavior change interventions; however, no single theory has demonstrated superiority in understanding the maintenance of PA. Rather, the determinants are likely multifaceted across contexts such as environmental, social support, and intrapersonal factors, and are apt to change with age.

Also, the present study limited the sample age to 45-64 years old; however, aging is a dynamic process rife with influences such as cohort effects, historical influences, and physical changes. Given that increased age is associated with steep declines in PA and increases in chronic diseases associated with inactivity, a better understanding of the unique aging-related barriers and facilitators for exercise across the adult lifespan are warranted (Ashe, Miller, Eng, & Noreau, 2009; Troiano et al., 2008). A recent editorial in the Journal of Aging and Physical Activity (Whaley, 2014) called for a developmental approach to physical activity research, particularly with regard to studying inter-individual differences among the heterogeneous older adult population. Little is known about differences between 50-, 60-, 70-, and 80-year-olds with regards to correlates and
barriers to physical activity. Similarly, Whaley (2014) calls for the inclusion of middle-aged adults in such research, as this population will not only contribute to the growing segment of older adults, but may live to be among the oldest-old. As such, it is crucial to understand the potential differences and commonalities between these groups to bridge research and practice, and to inform policy and interventions. Future research should replicate this model, utilizing more precise physical activity measures, in other middle-age and older adult samples to improve generalizability and understanding of the processes underlying PA.

Finally, understanding the social, environmental, and policy factors associated with PA was beyond the scope of this study, but these factors likely affect both levels of PA as well as variability and amenability of the latent constructs of interest in this study. A more careful dismantling of physical activity determinants in each decade of mid- and later life would more clearly inform barriers and facilitators for exercise, therefore informing more effective intervention targets for unique age groups.

**Implications**

The findings of the present study converge with those in the existing literature to support the primacy of self-regulation and self-efficacy in association with an individual’s level of physical activity. However, these findings differ with respects to some samples finding a mediating role of self-regulation on the indirect effect of self-efficacy on PA. For one, the present study lends some clarity to the mixed evidence for outcome expectations in influencing PA. The models analyzed herein suggested that outcome expectations contributed to explained variance in PA, but not in a direct fashion. This suggests that outcome expectations are an important correlate of PA and likely
influence activity by conferring greater self-efficacy and self-regulation for exercise. Models that have not included outcome expectations are missing a component of SCT and a proportion of explained variance in PA. These findings also found uniformly high rates of PA and self-efficacy, which differs from previous research and may be a response bias or a sampling bias.

Although the focus of the present study was on middle-aged adults, understanding determinants of physical activity may contribute to the process of successful aging across mid-life and into older adulthood. Successful aging, as defined by Rowe and Kahn (1987; 1997), is not merely the absence of age-related pathology, but rather a convergence of three related but distinct factors: low probability of disease, retention of cognitive and physical functioning, and active engagement with life. Rowe and Kahn further argue that with advancing age, the contribution of behavioral and environmental factors to health increases relative to genetic influence. PA is one such behavior with the potential to mitigate disease, preserve (and even increase) functioning, and serve as one form of meaningful activity throughout adulthood. Therefore, understanding determinants of PA in the context of middle adulthood may set a foundation for increasing and maintaining PA into later life via modifiable processes of self-efficacy and self-regulatory strategies.

**Directions for Future Research**

Despite strong factor loadings for measures in the model, the issues of measurement error and response bias are at the forefront of the present study. Future research is needed to rectify the issue of how to best measure physical activity, sedentary time, and exercise (both cardiovascular and strengthening), as measurement is a
cornerstone of science. To best understand and effectively intervene on PA, reliable and valid instrumentation is needed to assess prevalence of PA, monitor the effectiveness of interventions, monitor changes over time, and specify aspects of PA that are related to particular health outcomes (e.g., type, frequency, intensity, or duration of activity, etc.).

As discussed herein, certain methods likely overestimate PA (i.e., self-reported inventories, particularly retrospective questionnaires). Conversely, objective measures of PA may offer greater accuracy, depending on activity type, but at a greater cost and burden. Despite the increased attention to physical activity research since the 1990s, no consensus has been reached on how to best measure PA, which makes it challenging to monitor prevalence and compare findings across protocols.

Related to measurement issues, future research should aim to test the causal nature of the relationships between variables identified in the present model. A recent review by Olander and colleagues (2013) reviewed the effects of interventions on self-efficacy and physical activity among obese adults who tended to be middle-aged. Although they found a small effect of interventions on self-efficacy, the 42 intervention studies reviewed produced a medium effect on increasing PA behavior. Furthermore, there was no significant association between changes in self-efficacy and changes in PA. Rather, self-regulation strategies were associated with both increased self-efficacy and positive changes in PA. This is in contrast to an earlier review of healthy non-obese adults, in which a large relationship existed between increased self-efficacy and positive changes in PA (Williams & French, 2011). However, the participants in these reviews were all enrolled in PA interventions, which limit generalizability to sedentary community-dwelling adults. The results of the present study represent a cross-section of
middle-aged adults who may or may not be motivated to engage in exercise behavior for various reasons.

This discrepancy between intervention effects across populations makes clear the need to develop effective PA interventions that are tailored to specific populations. Future research should continue to evaluate other psychosocial determinants of physical activity, including social support and previous experience with exercise, particularly when such determinants can be modified or intervened upon to increase PA. While it may be time intensive and costly to develop this level of specificity, improved PA outcomes in various population segments may prove cost effective and improve population health.

As longevity increases in the US and worldwide, chronic diseases will continue to exert a personal and economic burden. Myriad evidence suggests that these conditions are associated with physical inactivity and may be prevented and/or managed with physical activity. Therefore, ongoing research is needed to not just design effective interventions for diverse populations across age groups, but also implement them and translate them to age-relevant settings. One such way may be to intervene on the modifiable intrapersonal determinants assessed in this study, rather than rely solely on increasing levels of physical activity. The present study provides evidence that self-regulation, self-efficacy, and attitudes and outcome expectations are intercorrelated and may influence PA levels in middle age. Future research should extend these findings to a multipronged approach that addresses both an individual’s PA behavior as well as the contexts in which it occurs.
REFERENCES


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86

APPENDIX A

University of Colorado
Colorado Springs
Institutional Review Board (IRB) for the Protection of Human Subjects

Date: 1/25/2016

IRB Review

IRB PROTOCOL NO.: 15.103
Protocol Title: Correlates of Physical Activity Engagement in Aging
Principal Investigator: Ereana Ream
Faculty Advisor if Applicable: Lilani Feliciano
Application: Renewal
Type of Review: Expedited
Risk Level: No more than Minimal Risk
Renewal Review Level (If changed from original approval) if Applicable: N/A No Change
This Protocol involves a Vulnerable Population: N/A (No Vulnerable Population)
Expires: 24 January 2017

“Note: If exempt: If there are no major changes in the research, protocol does not require review on a continuing basis by
the IRB. In addition, the protocol may match more than one review category not listed.

Externally funded: ☐ No ☑ Yes
OSP #:
Sponsor:

Thank you for submitting your Request for IRB Review for renewal of an approved protocol. The protocol identified
above has been reviewed according to the policies of this institution and the provisions of applicable federal regulations.
The review category is noted above, along with the expiration date, if applicable.

Once human participant research has been approved, it is the Principal Investigator’s (PI) responsibility to report any
changes in research activity related to the project:
  • The PI must provide the IRB with all protocol and consent form amendments and revisions.
  • The PI must approve these changes prior to implementation.
  • All advertisements recruiting study subjects must also receive prior approval by the IRB.
  • The PI must promptly inform the IRB of all unanticipated serious adverse (within 24 hours). All unanticipated adverse events
    must be reported to the IRB within 1 week (see 45CFR46.103(h)(2)). Failure to comply with these federally mandated
    responsibilities may result in suspension or termination of the project.
  • Renew study with the IRB prior to expiration.
  • Notify the IRB when the study is complete

If you have any questions, please contact Research Compliance Specialist in the Office of Sponsored Programs at 719-
255-3903 or osc@uccs.edu

Thank you for your concern about human subject protection issues, and good luck with your research.

Sincerely yours,

Michele Okusa, PhD
IRB Reviewer

www.uccs.edu/osp/compliance
Version 2/12/13
1420 Austin Bluffs Parkway Colorado Springs, CO 80918 719-255-3321 phone 719-255-3706 fax
APPENDIX B

STUDY QUESTIONNAIRE PACKET

We are interested in learning more about health habits among diverse groups of people. Information about personal characteristics helps us learn more about how different groups of people might be similar or different with regard to their health conditions and physical activity. Please be assured that all information you share with us will be labeled with a participant code number (not your name), and will be kept in strict confidence. Please remember to answer honestly and accurately. There are no right or wrong answers.

Using the scales listed below please indicate how confident you are that you will be able to walk briskly or exercise continuously for the different lengths of time specified.

For example, if you have complete confidence that you could walk briskly or exercise continuously for 20 minutes nonstop without quitting you would circle 100%. However, if you had no confidence at all that you could exercise for that long without quitting, you would circle 0%.

Mark your answer by circling a %:

<table>
<thead>
<tr>
<th>Question</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am able to walk briskly (or exercise continuously) for 5 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>2. I am able to walk briskly (or exercise continuously) for 10 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>3. I am able to walk briskly (or exercise continuously) for 15 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>4. I am able to walk briskly (or exercise continuously) for 20 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>5. I am able to walk briskly (or exercise continuously) for 25 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>6. I am able to walk briskly (or exercise continuously) for 30 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>7. I am able to walk briskly (or exercise continuously) for 35 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>8. I am able to walk briskly (or exercise continuously) for 40 MINUTES</td>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
</tbody>
</table>
The following items are similar to those you just completed. However, these questions are designed to assess your beliefs about your ability to exercise regularly (at least 3 times per week). Using the scales listed below please indicate how confident you are that you will be able to continue to exercise in the future.

For example, if you have complete confidence that you could exercise three times per week for the next week without quitting you would circle 100%. However, if you had no confidence at all that you could exercise without quitting, you would circle 0%.

Mark your answer by circling a %:

<table>
<thead>
<tr>
<th></th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am able to exercise three times per week without quitting for the <strong>NEXT WEEK</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2. I am able to exercise three times per week without quitting for the <strong>NEXT 2 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3. I am able to exercise three times per week without quitting for the <strong>NEXT 3 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>4. I am able to exercise three times per week without quitting for the <strong>NEXT 4 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>5. I am able to exercise three times per week without quitting for the <strong>NEXT 5 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>6. I am able to exercise three times per week without quitting for the <strong>NEXT 6 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>7. I am able to exercise three times per week without quitting for the <strong>NEXT 7 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>8. I am able to exercise three times per week without quitting for the <strong>NEXT 8 WEEKS</strong></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>
Please indicate how confident you are that you could exercise in the event that any of the following circumstances were to occur by circling the appropriate %.
Select the response that most closely matches your own, remembering that there are no right or wrong answers.

*I believe that I could exercise regularly (at least 3 times per week) if:*

<table>
<thead>
<tr>
<th>1. The weather was very bad (hot, rainy, cold, snowing)</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. I was bored by the program or activity</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. I was on vacation</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. I was not interested in the activity</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. I felt pain or discomfort when exercising</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. I had to exercise alone</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. It was not fun or enjoyable</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. It became difficult to get to the exercise location (e.g., the gym)</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. My schedule conflicted with my exercise session</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. I felt self-conscious about my appearance</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. I was under personal stress of some kind</th>
<th>Not at all Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10 20</td>
<td>30</td>
<td>40 50 60 70</td>
</tr>
</tbody>
</table>

Please rate how you feel at the moment about any physical activity you have been doing:

<table>
<thead>
<tr>
<th>1. I enjoy it</th>
<th>2 3 4 5 6 7 8 9 10 I hate it</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2</td>
<td>3 4 5 6 7 8 9 10 I feel interested</td>
</tr>
<tr>
<td>1 2</td>
<td>3 4 5 6 7 8 9 10 I like it</td>
</tr>
<tr>
<td>1 2</td>
<td>3 4 5 6 7 8 9 10 I find it pleasurable</td>
</tr>
<tr>
<td>1 2</td>
<td>3 4 5 6 7 8 9 10 I am not at all absorbed in this activity</td>
</tr>
</tbody>
</table>
Please rate how you feel *at the moment* about the physical activity you have been doing:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It’s no fun at all</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I find it energizing</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>It makes me depressed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>It’s very pleasant</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I feel good physically while doing it</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>It’s very invigorating</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I am very frustrated by it</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>It’s very gratifying</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>It’s very exhilarating</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>It’s not at all stimulating</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>It gives me a strong sense of accomplishment</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>It’s very refreshing</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I felt as though I would rather be doing something else</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>It’s not at all refreshing</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>It does not give me any sense of accomplishment at all</td>
<td></td>
</tr>
</tbody>
</table>
Please select the answer that best describes you:

1. I usually have more than one major exercise goal
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

2. I usually set dates for achieving my exercise goals
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

3. I tend to break more difficult exercise goals down into a series of smaller goals
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

4. I usually keep track of my progress in meeting my goals
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

5. I have developed a series of steps for reaching my exercise goals
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

6. I make my exercise goals public by telling other people about them
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

7. I never seem to have enough time to exercise
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

8. Exercise is generally not a high priority when I plan my schedule
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

9. Finding time for exercise is difficult for me
   
   | 1 | 2 | 3 | 4 | 5 |
   | Does Not Describe | Describes Moderately | Describes Completely |

10. I schedule all events in my life around my exercise routine
    
    | 1 | 2 | 3 | 4 | 5 |
    | Does Not Describe | Describes Moderately | Describes Completely |

11. I schedule my exercise at specific times each week
    
    | 1 | 2 | 3 | 4 | 5 |
    | Does Not Describe | Describes Moderately | Describes Completely |

12. I plan my weekly exercise schedule
    
    | 1 | 2 | 3 | 4 | 5 |
    | Does Not Describe | Describes Moderately | Describes Completely |
Please select the answer that best describes you:

13. When I am very busy, I don't do much exercise
   1  Does Not Describe  2  Describes Moderately  3  Describes Completely

14. I write my planned activity sessions in my appointment book or calendar
   1  Does Not Describe  2  Describes Moderately  3  Describes Completely

Below are statements that relate to ideas about exercise. Please indicate the degree to which you agree or disagree with the statements by circling SA for strongly agree, A for agree, D for disagree, or SD for strongly disagree.

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I enjoy exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Exercise decreases feelings of stress and tension for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Exercise improves my mental health.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Exercising takes too much of my time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I will prevent heart attacks by exercising.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Exercise tires me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Exercise increases my muscle strength.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Exercise gives me a sense of personal accomplishment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Places for me to exercise are too far away.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Exercising makes me feel relaxed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Exercising lets me have contact with friends and persons I enjoy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I am too embarrassed to exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Exercising will keep me from having high blood pressure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. It costs too much to exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------</td>
<td>----------</td>
<td>------------------</td>
</tr>
<tr>
<td>15. Exercising increases my level of physical fitness.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>16. Exercise facilities do not have convenient schedules for me.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>17. My muscle tone is improved with exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>18. Exercising improves functioning of my cardiovascular system.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>19. I am fatigued by exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>20. I have improved feelings of well-being from exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>21. My spouse (or significant other) does not encourage exercising.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>22. Exercise increases my stamina.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>23. Exercise improves my flexibility.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>24. Exercise takes too much time from family relationships.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>25. My disposition is improved with exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>26. Exercising helps me sleep better at night.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>27. I will live longer if I exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>28. I think people in exercise clothes look funny.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>29. Exercise helps me decrease fatigue.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>30. Exercising is a good way for me to meet new people.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>31. My physical endurance is improved by exercising.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>32. Exercising improves my self-concept.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>33. My family members do not encourage me to exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>34. Exercising increases my mental alertness.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>35. Exercise allows me to carry out normal activities without becoming tired.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>-----</td>
<td>---------------</td>
<td>-------</td>
<td>----------</td>
<td>------------------</td>
</tr>
<tr>
<td>36. Exercise improves the quality of my work.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>37. Exercise takes too much time from my family responsibilities.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>38. Exercise is good entertainment for me.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>39. Exercising increases my acceptance by others.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>40. Exercise is hard work for me.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>41. Exercise improves overall body functioning for me.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>42. There are too few places for me to exercise.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>43. Exercise improves the way my body looks.</td>
<td>SA</td>
<td>A</td>
<td>D</td>
<td>SD</td>
</tr>
</tbody>
</table>

We are interested in how people think about their bodies. Below are 10 different bodily attributes. We would like you to rank order these bodily attributes from that which has the greatest impact on your physical self-concept, to that which has the least impact on your physical self-concept.

Please first read over all of the attributes. Then, record your rank by writing the letter of the attribute in the appropriate place on the scale, from most important to your physical self-concept, on down to least important.

<table>
<thead>
<tr>
<th>BODILY ATTRIBUTE</th>
<th>LETTER OF ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. physical coordination</td>
<td>MOST IMPORTANT...............</td>
</tr>
<tr>
<td>b. health</td>
<td>2nd MOST IMPORTANT...............</td>
</tr>
<tr>
<td>c. weight</td>
<td>3rd MOST IMPORTANT...............</td>
</tr>
<tr>
<td>d. strength</td>
<td>4th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>e. sex appeal</td>
<td>5th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>f. physical attractiveness</td>
<td>6th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>g. energy level (e.g., stamina)</td>
<td>7th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>h. firm/sculpted muscles</td>
<td>8th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>i. physical fitness level</td>
<td>9th MOST IMPORTANT...............</td>
</tr>
<tr>
<td>j. measurements (e.g., chest, waist, hips)</td>
<td>LEAST IMPORTANT...............</td>
</tr>
</tbody>
</table>
Please answer the following questions as accurately and honestly as possible. There are no right or wrong answers.

1) In the PAST WEEK, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?
   This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job.

   Circle one: 0 1 2 3 4 5 6 7

2) In the PAST MONTH (30 or 31 days), on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?
   This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job.

   Circle one: 0 1 2 3 4 5 6 7

   8  9 10 11 12 13 14 15
   16 17 18 19 20 21 22 23
   24 25 26 27 28 29 30 31

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?
   
   ____ days per week

   [ ] No vigorous physical activities    ➔  Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?
   
   ____ hours per day
   ____ minutes per day

   [ ] Don’t know/Not sure
Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   __ days per week

   □ No moderate physical activities  \rightarrow Skip to question 5

   How much time did you usually spend doing moderate physical activities on one of those days?

   __ hours per day

   __ minutes per day

   □ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

   __ days per week

   □ No walking  \rightarrow Skip to question 7

6. How much time did you usually spend walking on one of those days?

   __ hours per day

   __ minutes per day

   □ Don't know/Not sure
This question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?
   
   _____ hours per day
   _____ minutes per day
   
   [ ] Don't know/Not sure

For the following questions, please answer as best as you can, based on your own knowledge:

1) How many days a week of physical activity or exercise are recommended for the average adult to stay healthy? Write in answer:

   ________________________________________________________________ (specify minutes or hours)

2) On those days, how long should the average adult be physically active to stay healthy? Write in answer:

   ________________________________________________________________ (specify minutes or hours)

Indicate how often each of the statements below is descriptive of you:

1) I lack companionship
   1. Never  2. rarely  3. sometimes  4. often

2) I feel left out.
   1. Never  2. rarely  3. sometimes  4. often

3) I feel isolated from others.
   1. Never  2. rarely  3. sometimes  4. often

In general, would you say your health is... (circle one number)

Excellent: 1  Very good: 2  Good: 3  Fair: 4  Poor: 5
Over the past 2 weeks, how often have you been bothered by the following problems?

1. Little interest or pleasure in doing things
   0 not at all  1 several days  2 more than half the days  3 nearly every day

2. Feeling down, depressed, or hopeless
   0 not at all  1 several days  2 more than half the days  3 nearly every day

On a scale of 0 to 10, with 0 being “no pain” and 10 being “pain as bad as you can imagine:”

1) Rate your pain at its worst in the last week:
   0 1 2 3 4 5 6 7 8 9 10

2) Rate your pain at its least in the last week:
   0 1 2 3 4 5 6 7 8 9 10

3) Rate your pain on average in the last week:
   0 1 2 3 4 5 6 7 8 9 10

4) Rate your pain right now:
   0 1 2 3 4 5 6 7 8 9 10

Which of the following legal substances do you use or ingest (regularly or recreationally):

1. Alcohol
   YES NO
   If yes, how many drinks per week? _______________________

Note: 1 drink is defined as any one of the following: 12 fl oz of beer; 8-9 fl oz of malt liquor; 5 fl oz of table wine; 3-4 oz of fortified wine (such as sherry or port); 2-3 fl oz of cordial, liqueur, or aperitif; 1.5 fl oz of brandy (a single jigger or shot); or 1.5 fl oz shot of 80-proof spirits (“hard liquor”)

2. Tobacco
   a. No
   b. Yes, cigarettes (Number of cigarettes per day: ____________)
   c. Yes, cigars (Number of cigars per day: ____________)
   d. Yes, electronic cigarettes
   e. Yes, chewing tobacco

3. Caffeine
   YES NO
   If yes, please specify what type (e.g., coffee, tea, etc.) and how many servings/day:
   ______________________
The following are questions about your medical history:

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>Do you have the problem?</th>
<th>Do you receive treatment for it?</th>
<th>Does it limit your activities?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Heart disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Lung disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Diabetes</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Ulcer or stomach disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Liver disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Anemia or other blood disease</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Cancer</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Depression</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Anxiety</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Osteoarthritis or degenerative arthritis</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Back pain</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Other medical problems (please write in below)</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
The following questions are for classification purposes and will help us better understand differences and similarities between people.

1. Age: ____________________________ 2. Gender: ____________________________

3. Zip code: ____________________________

4. Please select the racial category(ies) with which you identify: (select all that apply)
   - White (a person having origins in Europe, the Middle East, or North Africa)
   - Black or African American (a person having origins in any of the Black racial groups of Africa)
   - American Indian or Alaska Native (a person having origins in North and South America, including Central America, and who maintains, tribal affiliation or community attachment)
   - Asian (a person having origins in the Far East, Southeast Asia, or the Indian subcontinent)
   - Native Hawaiian or other Pacific Islander (a person having origins in Hawaii, Guam, Samoa, or other Pacific Islands)
   - Other (please describe): ____________________________
   - Decline to respond

5. Are you Hispanic? (circle one) Yes No

6. How many years of education have you completed? ________

7. Please indicate the highest degree you hold: (select one)
   - No degree/diploma
   - High School diploma
   - Bachelor’s degree (BA, BS, etc.)
   - Professional school degree (MD, DDS, DVM, JD, etc.)
   - Associate’s degree (AA, AS, etc.)
   - Master’s degree (MA, MS, MBA, etc.)
   - Doctoral degree (PhD, EdD, etc.)

8. The next questions are about your current job or business. Which of the following were you doing last week?… (select one)
   - Working at a job or business
   - With a job or business but not at work
   - Looking for work
   - Not working at a job or business

9. If you did not work last week, what is the main reason? (select one)
   - Taking care of house or family
   - Going to school
   - On layoff
   - Unable to work for health reasons
   - Retired
   - Disabled
   - Other (describe: ____________________________ )
10. What is your primary occupation? If retired, please list your prior occupation.

Income is important in analyzing the health information we collect. For example, this information helps us to learn whether persons in one income group use certain types of medical services or have certain conditions more or less often than those in another group.

11. What is your total household annual income before taxes? Please include income from all sources such as wages, salaries, Social Security or retirement benefits, VA benefits, help from relatives, and so forth. (circle one)

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Income Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0—$13,000</td>
<td>$38,001—$44,500</td>
</tr>
<tr>
<td>$13,001—$19,500</td>
<td>$44,501—$51,000</td>
</tr>
<tr>
<td>$19,501—$25,500</td>
<td>$51,001—$57,500</td>
</tr>
<tr>
<td>$25,501—$31,500</td>
<td>$57,501—$64,000</td>
</tr>
<tr>
<td>$31,501—$38,000</td>
<td>$64,000—above</td>
</tr>
</tbody>
</table>

12. Do you have more than $5,000 in savings at this time? Please include cash, checking accounts, stocks, bonds, mutual funds, retirement funds (e.g., pensions, IRAs, 401Ks, etc.), and certificate of deposit. (circle one)  Yes  No

13. What is your relationship status? (select one)

<table>
<thead>
<tr>
<th>Relationship Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married/Domestic Partnership/Civil Union</td>
</tr>
<tr>
<td>Separated</td>
</tr>
<tr>
<td>Cohabitating/Living as married</td>
</tr>
<tr>
<td>Widowed</td>
</tr>
<tr>
<td>Divorced</td>
</tr>
<tr>
<td>Single/Never married</td>
</tr>
</tbody>
</table>

14. Is anyone in your family or any of your friends physically active 3-5 times every week? (circle one)  Yes  No

If yes, who? _____________________________________________

What activities do they do? __________________________________

Please fill in the following to the best of your knowledge:

Weight (without shoes or outerwear): ________ lbs

Height (without shoes or headwear): ________ ft ________ inches

***** This is the end of the questionnaire. Please return to the researcher. Thank you for participating. *****