

**Measuring the Impact of Volunteering on Physical Activity
Using Data from the Health and Retirement Study**

BY

JULIA R. CLARK

B.S., Simmons College, 2006

MPH, University of Illinois at Chicago, Chicago, 2012

THESIS

Submitted as partial fulfillment of the requirements for the degree of Doctor
of Philosophy in Public Health Sciences in the Graduate College of the
University of Illinois at Chicago, 2016

Chicago, Illinois

Defense Committee:

Susan Hughes, Chair and Advisor

Timothy Johnson, Survey Research Laboratory

David Marquez, Kinesiology and Nutrition

Jessica Faul, Survey Research Center, University of Michigan

Amy Eisenstein, Institute for Health Research and Policy

This work is dedicated to my family without whom completion of this journey would not have been possible.

ACKNOWLEDGMENTS

I would like to thank my dissertation committee, Drs. Susan Hughes, David Marquez, Amy Eisenstein, Timothy Johnson and Jessica Faul. Each member of this team played an integral role in challenging and supporting me to ensure the most accurate, timely and relevant material was presented. I am especially grateful to my academic advisor and committee chair, Susan Hughes who has advised and guided me throughout my graduate studies. The consistent and rigorous guidance she has given me while still allowing me to creatively explore my passions made this journey both challenging and exciting and will surely provide me with invaluable experience to guide my career.

I am also indebted to the staff of the HRS at the University of Michigan who allowed me to attend seminars, ask unlimited questions and provided access to this incredible data. I would also like to acknowledge Dyanna Gregory-Carlos for her patience and generosity in offering endless hours of assistance with my data analysis. Finally, I am eternally grateful to my immediate family who never doubted me or allowed me to doubt myself. Their support from the outset of my studies never wavered and I truly would not have been able to complete this journey without them.

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
I. INTRODUCTION	1
A. Background	1
1. Physical Activity	3
2. Volunteering	5
B. Theory	7
1. Socioemotional Selectivity	7
2. Generativity Theory	8
C. Conceptual Model	10
1. Figure 1: Conceptual Model of Volunteering and Physical Activity	11
2. Statement of the Problem	12
D. Purpose of the Study	13
E. Research Questions	13
F. Type of Study	15
1. Study Strengths	15
2. Study Limitations	16
G. Significance	17
H. Summary	18
II. REVIEW OF RELEVANT LITERATURE	20
A. Introduction	20
B. Background	20
1. Characteristics of Older Adult Volunteers	20
C. Literature Search Methods	21
1. Screening the Literature	22
2. Inclusion Criteria and Justification	22
D. Critical Review of the Literature	26
1. Data Extraction and Synthesis	26
E. Results	32
1. Volunteering and Health	32
a. Morbidity and Mortality	32
b. Hypertension	34
c. Self-Rated Health	34
d. Life Satisfaction	35
e. Physical Activity	35
2. Intensity and Duration of Volunteering	37
3. Threshold for Volunteering	38
4. Maintenance of Volunteering	38

TABLE OF CONTENTS (continued)

<u>CHAPTER</u>	<u>PAGE</u>
5. Theoretical Perspectives of Volunteering	39
a. Socioemotional Selectivity Theory	39
b. Generativity	40
6. Limitations	43
7. Implications for Research	44
F. Conclusion	45
III. RESEARCH DESIGN AND METHODOLOGY	47
A. Study Design	47
B. Data Source – The Health and Retirement Study	47
C. Study Sample and Selection of Data Sets	48
1. Target Population of the Health and Retirement Study	51
D. Measures	52
1. Dependent Measures	54
a. Assessment of Physical Activity	55
2. Independent Variables	56
a. Characteristics of Volunteers	57
b. Predictors of Generative Volunteering	58
3. Other Outcomes of Interest	59
a. Functional Limitations	59
b. Depression	59
4. Covariates	59
E. Analysis	60
1. Data Acquisition and Preparation	60
2. Missing Data and Multiple Imputation	62
3. Grouping	62
4. Univariate and Bivariate Analyses	63
5. Modeling Strategy	63
F. Human Subjects Protection	66
1. University of Illinois at Chicago Institutional Review Board	66
2. Health and Retirement Study	66
IV. RESULTS	68
A. Sample Description	68
1. Study Sample	68
2. Descriptive Statistics	69
B. Impact of Covariates on Physical Activity	70
1. Demographics and Covariates	70
C. Multivariate Effects of Volunteering on Physical Activity	77
1. Volunteering	77
2. Volunteer Intensity	80

TABLE OF CONTENTS (continued)

<u>CHAPTER</u>	<u>PAGE</u>
3. Volunteering with Children	81
D. Review of Study Aims and Hypotheses.....	85
1. Hypothesis 1 and 2.....	85
2. Hypothesis 3.....	85
3. Hypothesis 4.....	86
4. Hypothesis 5.....	86
E. Conclusions.....	88
V. CONCLUSIONS.....	89
A. Discussion	89
B. Discussion of Individual Analyses.....	92
C. Covariate Selection	93
D. Multivariate Modeling	93
1. Primary Outcomes	93
2. Secondary Outcomes	96
E. Summary and Study Implications	97
F. Limitations and Future Research	99
G. Conclusions.....	101
APPENDICES	103
Appendix A.....	104
Appendix B	111
Appendix C	116
Appendix D	127
Appendix E	128
Appendix F.....	129
Appendix G.....	132
Appendix H.....	135
Appendix I	136
Appendix J	137
Appendix K.....	139
Appendix L	141
CITED LITERATURE	143
VITA	152

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>
I. CHARACTERISTICS OF VOLUNTEERING STUDIES	23
II. CRITICAL APPRAISAL OF EACH STUDY/ QUALITY ASSESSMENT (EPHPP TOOL)	27
III. MEASURES	61
IV. DESCRIPTIVE STATISTICS OF SAMPLE VOLUNTEERS (ANY TYPE) VS. NON-VOLUNTEERS IN 2008	71
V. DESCRIPTIVE STATISTICS OF GENERATIVE VERSUS NON- GENERATIVE VOLUNTEERS IN 2008	74
VI. LOGISTIC REGRESSION MODEL OF VOLUNTEERING AND COVARIATES WITH LIKELIHOOD TO REPORT MEETING PA GUIDELINES	78
VII. CORRELATIONS OF VOLUNTEER INTENSITY AND PHYSICAL ACTIVITY (MEETS GUIDELINES)	82
VIII. SPEARMAN CORRELATION FOR VOLUNTEERING WITH CHILDREN AND MEETS OR DOES NOT MEET PHYSICAL ACTIVITY GUIDELINES, 2008	82
IX. SPEARMAN CORRELATION FOR VOLUNTEERING WITH CHILDREN AND INTENSITY OF PHYSICAL ACTIVITY	83
X. SPEARMAN CORRELATIONS OF VOLUNTEERING WITH CHILDREN AND PHYSICAL ACTIVITY AT FOUR TIME POINTS	83
XI. CORRELATION OF PSYCHOSOCIAL VARIABLES WITH GENERATIVE VOLUNTEERING AT BASELINE	87
XII. CODEBOOK OF VARIABLES	116
XIII. INDEPENDENT VARIABLES	127
XIV. SOCIOEMTIONAL SELECTIVITY VARIABLES	128
XV. DESCRIPTIVE STATISTICS OF PHYSICAL ACTIVITY (MEETS/DOES NOT MEET GUIDELINES) AT BASELINE	129

XVI.	DESCRIPTIVE STATISTICS: PHYSICAL ACTIVITY INTENSITY AT BASELINE	132
XVII.	SPEARMAN CORRELATIONS OF VOLUNTEERING AND MEETS OR DOES NOT MEET PHYSICAL ACTIVITY GUIDELINES IN 2008	135
XVIII.	SPEARMAN CORRELATIONS OF VOLUNTEERING AND INTENSITY OF PHYSICAL ACTIVITY IN 2008	136
XIX.	SPEARMAN CORRELATIONS OF VOLUNTEER STATUS AND SECONDARY OUTCOMES	137
XX.	SPEARMAN CORRELATIONS OF VOLUNTEER INTENSITY AND SECONDARY OUTCOMES	139
XXI.	SPEARMAN CORRELATIONS OF VOLUNTEERING WITH CHILDREN AND SECONDARY OUTCOMES	141

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1.	Conceptual model of volunteering and physical activity	11
2.	Data sets and measures used for analysis	53
3.	Overview of study sample	53

LIST OF ABBREVIATIONS

ACL	Americans Changing Lives
ACSM	American College of Sports Medicine
ADL	Activities of daily living
AHEAD	The Asset and Health Dynamics among the Oldest Old
BLS	Bureau of Labor Statistics
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
CES-D	Center for Epidemiologic Studies – Depression
CRF	Corticotropin-releasing factor
CVD	Cardiovascular disease
EFTG	Enhanced Face to Face
EPHPP	Effective Public Health Practice Project
FXNL	Functional
HRS	Health and Retirement Study
IADL	Instrumental activities of daily living
ISR	Institute for Survey Research at University of Michigan
LB	Leave behind
LSA	Longitudinal Study of Aging
MAR	Missing at random
MCAR	Missing completely at random
MIDUS	Midlife in the United States
MTV	Motivations to volunteer

LIST OF ABBREVIATIONS (continued)

NIA	National Institute of Aging
NIH	National Institute of Health
OA	Older adult
PA	Physical activity
RAND	Research and Development
RCT	Randomized Controlled Trial
SES	Socioeconomic Status
SST	Socioemotional Selectivity Theory
USDHHS	United States Department of Health and Human Services
VAT	Visceral adipose Tissue
WHO	World Health Organization

SUMMARY

The purpose of this study was to examine the association between volunteering and physical activity in a nationally representative sample of adults age 50 and older. Specifically, this study examined the association between volunteering and measures of physical activity including meeting current recommended guidelines and reported levels of intensity.

To address this purpose, a secondary data analysis was conducted using data from the Health and Retirement Study, a nationally representative sample of the U.S. population. Health factors and demographic characteristics assessed in 2008 were used as baseline data. Volunteer variables were assessed in 2008, 2010, 2012, and 2014 and were used in the analyses as independent variables. Physical activity was assessed as meets or does not meet guidelines and by intensities of mild, moderate, and vigorous in 2008, 2010, 2012, and 2014.

The primary analysis was designed as a four-wave observation longitudinal model to examine the impact of volunteering on physical activity. Analyses also included a series of bivariate and multivariate statistical models to examine the effects of volunteering on secondary outcomes including depression, functional status, and self-rated health while accounting for baseline demographic and health information.

The resulting findings were that volunteering was associated with meeting physical activity guidelines over time. When controlling for baseline physical activity of volunteers and non-volunteers, volunteers were still more likely to meet physical activity guidelines and sustain a higher likelihood to meet guidelines over the four waves of data.

SUMMARY (continued)

This analysis is unique in several ways. (1) It includes measurement of outcomes at four different time points, (2) it analyzes effects of volunteering independently and in longitudinal models, and, finally, (3) it analyzes volunteering with a wide variety of covariates. These findings begin to clarify the associations between volunteering and physical activity in older adults. The findings suggest that volunteering may result in promoting physical activity and maintaining physical activity over time. Additionally, these findings indicate that volunteers are less likely to be depressed, have better functional status, and report fewer comorbid conditions than non-volunteers over multiple time points.

I. INTRODUCTION

A. Background

A physically active lifestyle is one of the top 10 health indicators for Americans in the Healthy People 2020 objectives (CDC, 2010). Conversely, inadequate physical activity (PA) is a leading preventable cause of morbidity and mortality (Conn, Phillips, Ruppar, and Chase, 2012). Physical inactivity is associated with many of the most common chronic diseases, including heart disease, type 2 diabetes, hypertension, obesity, osteoporosis, depression, and breast and colorectal cancers (Strath, Kaminsky, Ainsworth, Ekelund, Freedson, Gary, et al., . . . 2013). Despite these documented risks, older Americans are the least physically active of any age group (Nelson, Rejeski, Blair, Duncan, Judge, King, Macera, and Castaneda-Sceppa, 2007) with 70 percent of able-bodied older adults remaining sedentary.

One approach to increasing physical activity in older adults involves volunteering. Enhanced engagement in PA as a byproduct of volunteering has emerged as a potential mechanism to combat the sedentary and inactive behaviors of many older adults (Tan, Xue, Li, Carlson, and Fried, 2006). Further, research has shown that programs that promote PA as part of daily living can be as or more effective than structured exercise programs in helping people meet nationally recommended levels of PA (Dunn, Marcus, Kampert, Garcia, Kohl, and Blair, 1999).

According to the U.S. Bureau of Labor Statistics, approximately 62.8 million people volunteered through or for an organization at least once between September 2013 and September 2014. During this 12-month time period volunteers spent a median of 50 hours annually on volunteer activities. Time spent

on volunteer activities was similar for women and men. Among persons who volunteered, 25 percent of the total population and 64 percent of older adults, those 65 and older, had the highest median annual hours spent volunteering at 96 hours (reported as number of hours in the last year) (U.S. Department of Labor Bureau of Labor Statistics, 2014).

According to the Marriott Seniors Volunteerism Study (Marriott Senior Living Services, 1991), “for every 10 older adults who volunteered, there were approximately 3.4 latent volunteers (not active but would volunteer if asked) and 5.9 conditional volunteers (not active but might volunteer in certain situations if asked)” (Okun and Schultz, 2003). In light of this large untapped pool of potential volunteers, and the known health benefits of volunteering, it is important to understand what motivates older adults to volunteer. A review of motivations to volunteer (MTV) found that as older adults age, their motivations for volunteering shift. Socioemotional Selectivity Theory (SST) posits that, the older adults become, the more they will be motivated by other-oriented reasons such as giving back rather than self-oriented reasons such as career development or making new friends (Okun and Schultz, 2003). Omoto et al. (2000) also found that age was inversely related to relationship MTV (e.g., making new friends) and positively related to service MTV (such as giving back). Their study found a correlation of .40 between relationship and service. Omoto et al. (2000) also reported that age remained significantly correlated with each motive for volunteering when the “other” motive for volunteering was removed, indicating that as adults age they seem to be motivated to volunteer regardless of the reason (Omoto et al., 2000 as cited in Okun and Schultz, 2003). The present study focuses on formal volunteering including the “other-oriented” reasons as outlined by the SST and explored in more detail below. To date, no research has

expressly examined the association between formal volunteering and engagement in overall physical activity, including intensity and likelihood to meet guidelines, in older adults. The present study aims to address this research gap by directly examining this relationship.

1. **Physical Activity**

National physical activity guidelines for older adults recommend 30 minutes of physical activity five times a week and encourage both physical activity and avoidance of sedentary behavior, which have emerged as two distinct concepts in health promotion. Recent research indicates that even being somewhat less sedentary can have a large impact on older adult health (Owen, Healy, Matthews, and Dunstan, 2010). Being physically active is critical for improved survival and functional status, including delayed mortality and progression of frailty in older adults (Hughes, Marquez, Nguyen, Desai, and Jones, 2011). The literature indicates that even being somewhat *less* sedentary through engagement in some activity that breaks up time spent sitting is beneficial to older adults' health and survival (Owen et al., 2010).

Multiple studies have documented various benefits of physical activity on health outcomes for older adults. Findings of a review of three separate randomized controlled trials (RCTs) on the impact of sedentary behavior and health from Blair and Morris (2009) demonstrate the importance of adequate regular exercise in maintaining cardiovascular health and preventing disease. Recognition of the beneficial effects of exercise on physiological functions, including blood pressure and lipids, and physical and social capabilities continues to grow (Blair and Morris, 2009). For example, people who exercise regularly are less likely to experience stroke (Booth, Roberts, and Laye, 2012;

Blair and Morris, 2009), certain types of cancer, type 2 diabetes, obesity, osteoporosis, and loss of function and autonomy in older ages (Blair and Morris, 2009; Strath et al., 2013). Annual reviews from the American College of Sports Medicine and the American Heart Association also recommend regular physical activity for older adults to reduce risk of cardiovascular disease, thromboembolic stroke, hypertension, type 2 diabetes, osteoporosis, obesity, colon cancer, breast cancer, anxiety, and depression (Blair and Morris, 2009; Chodzko-Zajko, Schwingel, and Park, 2009; Owen, Healy, Matthews, and Dunstan, 2010; Booth et al., 2012; Seguin, Buchner, Liu, Manini, Wang, and Lacroix, 2014).

Conversely, a recent study by Booth and colleagues (2012) found that physical inactivity is a primary cause of chronic disease by initiating 35 separate pathological and clinical conditions, including functional limitations, chronological aging, metabolic syndromes, obesity, cardiovascular diseases (CVDs), cognitive function and related diseases, digestive tract diseases, and pulmonary and kidney diseases (Booth et al., 2012). Even short-term reductions in physical activity such as daily step numbers cause decreases in corticotropin-releasing factor (CRF), loss of insulin sensitivity, reduced lean mass, and increased visceral adipose tissue (VAT), which can all lead to detrimental health effects in older adults. These findings help explain how reduced physical activity is related to risk associated with progression of chronic diseases and highlight the need to stay active throughout old age (Booth et al., 2012; Blair and Morris, 2009). Finally, a recent study on 92,234 women aged 50–79 years who participated in the Women’s Health Initiative Observational Study found that, “at mean follow up of 12 years, compared with women who reported the least sedentary time, women reporting the

highest sedentary time had a significant increased risk of all-cause mortality” (including CVD and cancer) after controlling for multiple potential confounders including self-rated health and physical activity (Seguin, Buchner, Liu, Allison, Manini, Wang, Manson, Messina, Patel, Moreland, Stefanick, and LaCroix, 2014). Taken together, these findings underscore the need for research, policy, and practice to promote physical activity in older adulthood, avoidance of sedentary behavior, and the importance of breaking up sedentary time with short bouts of PA.

2. **Volunteering**

Volunteering is defined as, “any activity in which time is given freely to benefit another person, group, or cause” (Wilson, 2000). Volunteerism refers to engagement in proactive activities that involve commitment and whose benefits extend beyond the individual volunteer (Wilson, 2000). Research shows a strong relationship between volunteering and health. Those who volunteer have lower mortality rates (Harris and Thoresen, 2005; Ayalon, 2008), greater functional ability (Barron, Tan, Yu, Song, McGill, and Fried, 2009; Jenkinson, Dickens, Jones, Thompson-Coon, Taylor, Rogers, Bamba, Lang, and Richards, 2013), and lower rates of depression later in life than those who do not volunteer (Morrow-Howell, Hinterlong, Rozario, and Tang, 2003; Jenkinson et al., 2013). Additionally, older adults in fair or poor health who regularly volunteer have reported increased strength, energy, and well-being and have shown clinically relevant improvements in performance measures of walking speed and stair climbing (Barron et al., 2009).

A recent systematic review and meta-analysis of 40 papers on volunteering and health that included five RCTs and seventeen cohort studies found that, “volunteering

may benefit mental health and survival, although causal mechanisms remain unclear” (Jenkinson et al., 2013). Studies reviewed demonstrated a relationship between volunteering and depression, life satisfaction, and well-being but not on physical health (Jenkinson et al., 2013). However, findings from experimental studies reviewed were mixed. Five trials that investigated the health effects of intergenerational volunteering among older adults found positive associations between physical activity and cognitive function but no significant effects for depression or self-rated health. The studies reviewed tended to have smaller sample sizes, which the author notes, “were likely to be underpowered in detecting important between-group differences, and this flaw was exacerbated by sample attrition” (Jenkinson et al., 2013). As a result, the effect of volunteering on depression and self-rated health is still unknown. Additionally, the meta-analysis found insufficient evidence to demonstrate a consistent influence of either volunteering *type* or *intensity* on the explored outcomes, highlighting a need for future research that explicitly connects volunteering to specific health outcomes and uses RCT methodology to test the effects of volunteering on health and physical activity (Jenkinson et al., 2013). A 1999 survey administered to 2,032 adult-age volunteers (ages 18 and up) by Librett, Yore, Buchner, and Schmidt (2005) found volunteers were more likely to meet physical activity guidelines than non-volunteers and that, in general, volunteers reported more physical activity than non-volunteers controlling for volunteering type. Retired volunteers were also 1.5 times more likely to meet physical activity guidelines than non-retired volunteers. These findings signify a potential for volunteering, particularly among retirees, as a potential mechanism to both meet physical activity guidelines and become more physically active.

In summary, although several studies provide valuable insight into the relationship between volunteering and health in older adults, each lacks components critical to understanding the relationship between volunteering, physical activity, and health outcomes in older adults. Thus, more research examining the relationship between volunteering and physical activity of older adults is strongly recommended.

B. **Theory**

Gerontologists often examine the role of theories and life course perspectives in their investigations of volunteering and well-being. This study will be guided by socioemotional selectivity theory with the generativity theory nested within as outlined by Cartensen, Isaacowitz, and Charles (1999) and Erik Erikson (1983).

1. **Socioemotional Selectivity**

Socioemotional Selectivity Theory posits that aging transforms priorities for goals and motivations, changing from knowledge-related goals (understanding) to emotionally meaningful goals (values or social). As older adults progress through the life course they have more “present-oriented” goals related to emotional fulfillment such as the pleasure of knowing they are needed and engaged in socially meaningful activities (Cartensen, Isaacowitz, and Charles, 1999). These priorities are manifested in shifts in volunteer behavior from social goals that involve expanded opportunities for social interaction to social goals that involve maintenance of one’s well-being and investment in civically focused social activities (Okun and Schultz, 2003). According to SST, prioritization of personal goals is influenced by the perceived amount of time remaining in one’s life. When time is perceived as more limited, which naturally occurs with aging, motivation shifts toward a need to derive emotional meaning from life and less toward

expanding one's horizons. As a result of perceiving time as more limited, older adults are predicted to show a greater focus on goals related to emotions and emotional regulation, generativity, and social selection, which is defined by an increased focus on close relationships (e.g., more time with children, wife, more frequent contact with close friends). In contrast, as a result of perceiving time as being more expansive, younger adults are predicted to show a greater focus on goals related to knowledge acquisition or novelty (e.g., learn a new language, endeavor to advance a career through a charity organization).

2. **Generativity Theory**

Generativity is defined as a concern for others developed during middle age, and is often expressed through volunteer behaviors that involve giving back to younger generations. Although older adults are motivated to volunteer by many factors, this study focused on generativity, which involved volunteering for younger generations as posited by SST and generativity theory.

Generativity, first introduced in the 1950s by Erik Erikson, is a psychosocial theory that explains why persons engage in activities that contribute to the well-being of others, particularly younger generations (Gruenewald, 2012). Erikson defines generativity as the expansion of care beyond oneself, towards others, and transferring knowledge and wisdom to younger generations (Erikson, 1983). Older adults' desires to remain important and feel needed are thought to play into their motivations for engagement in generative activities such as volunteering. Generativity is concerned with the idea of giving back and is linked to reduced risk of mortality, better cognitive and physical functioning, and greater levels of well-being in older adulthood (Gottlieb and

Gillespie, 2008). Generativity that is expressed in the form of volunteering is associated with delayed mortality (Harris and Thorensen, 2005; Konrath, Fuhrel, Lou, and Brown, 2012; Martinson and Minkler, 2006; Morrow-Howell, Hinterlong, Rozario, and Tang, 2003).

Erikson's work "implies that harnessing the untapped desire for generativity in an aging population could lead to benefits for both society and the older adults themselves," (Glass, Freedman, Carlson, Hill, Frick, Ialongo, ... and Fried, 2004, p. 96). The benefits of generativity are limited only by the number of available opportunities for generative role performance. A recent study by Gruenewald et al. (2015) found that older adults who engaged in generative role performance had higher levels of generative desire and generative achievement at six, 12, and 24-month follow up than those who did not. This theory suggests that the desires of emerging cohorts of Baby Boomers to remain productively engaged in retirement and to help children would also help the cohorts themselves (Gruenewald, 2012). Therefore, examining whether generativity motivates engagement in volunteer activities and whether generative volunteering leads to increased physical activity in older adults is a critically important research question.

A consideration of the application of generativity theory to older adult volunteers leads to the following query: What type(s) of volunteering is associated with increased physical activity in older adults? Specifically, do the benefits of volunteering, such as physical activity, self-reported health, functional ability, and fewer depressive symptoms, differ when volunteering includes an opportunity for generative fulfillment (volunteering with children) versus volunteering for a church or other organization?

In order to explore these questions, an additional perspective is necessary that can inform

the application of generativity theory to examinations of volunteering and physical activity in older adults. The perspective that is needed is described in brief below with more detail in Chapter 3 (methodology) along with core principles and implications for research in this area.

C. **Conceptual Model**

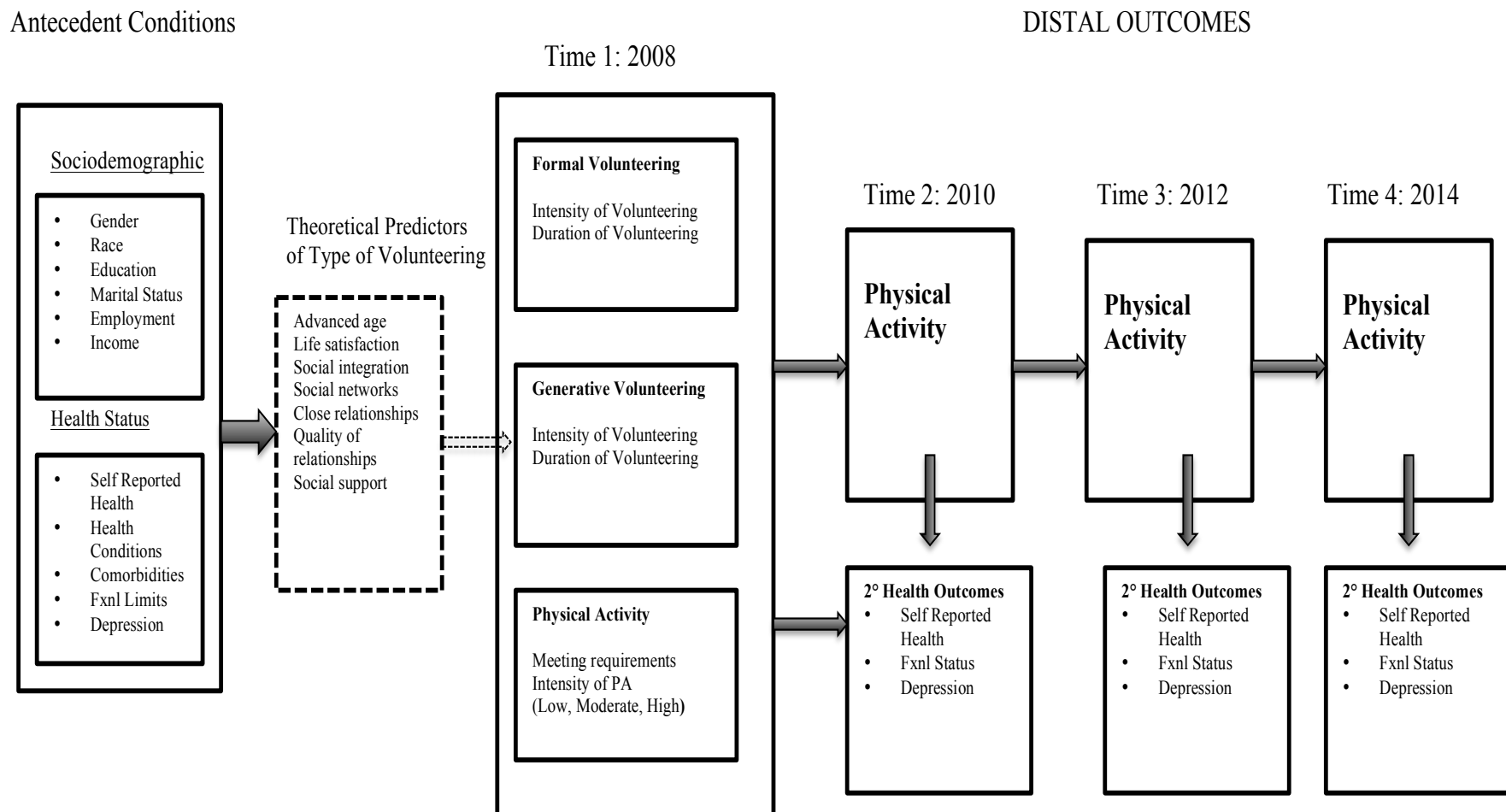
The relationship between volunteering and physical activity as well as the role played by the underexplored generativity theory are the topics of this dissertation.

1. **Conceptual Model of Volunteering and Physical Activity**

The conceptual model that outlines the theorized pathway leading from volunteering to physical activity outcomes is shown below (Figure 1). This model outlines a two-stage approach to the analyses. The first stage involved an examination of the characteristics of volunteers versus non-volunteers in four cohorts of older adults followed for a period of eight years. The second stage examined the determinants and differential effects of volunteering with children or young people versus “other” formal volunteering on the intensity and duration of volunteering and physical activity and health-related outcomes over the same time period.

According to SST, the desires of older adults to know they are needed and engaged in socially meaningful activities as well as their need to give back to younger generations will lead them to be motivated to volunteer with younger generations, including children (generativity). The presence of generativity in this model is expressed through the act of volunteering with children.

Figure 1: Conceptual model of volunteering and physical activity



Formal volunteering with children versus other populations or organizations leads to older adults' being more physically active for two separate but interrelated reasons: (1) older adults are more likely to be active because of the tasks involved in volunteering themselves, particularly if they are working with younger generations, and (2) older adults will have a greater sense of purpose and be more inclined towards engaging in self-care to ensure they can fulfill these obligations that are meaningful to them. Previous work by Gruenewald and colleagues with Experience Corps volunteers found that civic engagement can improve perceived generativity in older adulthood (Gruenewald et al., 2015). Based on this finding, it was hypothesized that if volunteer activity that is motivated by generativity is more meaningful to older adults and if it increases their engagement in physical activity through which they experience superior health benefits, generative older adult volunteers will devote more hours to volunteering over time and will volunteer for a longer duration of time than older adults who engage in volunteering that does not incorporate a generative component (Gruenewald, Tanner, Fried, Carlson, Xue, Parisi, ... and Seeman, 2015).

2. **Statement of the Problem**

Although several studies provide valuable insight into the relationship between volunteering and health in older adults, each lacks components that are critical to understanding the relationship of volunteering to physical activity in older adults. As a result, the temporal relationships between volunteering and physical activity are still unknown and important to understand. Volunteers may increase their engagement in physical activity through their volunteer work, but those who are more physically active also might be more inclined to volunteer in the first place and to volunteer to work with

children as opposed to some other less physically demanding type of volunteer work. Volunteers may also need to maintain a certain level of physical activity ability to remain engaged in their volunteer work. The systematic review of the literature, summarized in Chapter 2, proposes that the temporal relationship between physical activity and volunteering should be further examined quantitatively. Specifically, a longitudinal study of this question is needed to identify possible causal pathways and help designate areas of attention for future intervention studies that seek to combine physical activity and volunteering (Librett et al., 2005).

D. **Purpose of the Study**

It is well known that physical activity benefits older adults, that sedentary behavior is harmful, and that volunteering is linked to positive health outcomes. The purpose of this study was to fill gaps in knowledge by quantitatively answering the following questions and testing the hypotheses specified below.

This study used a longitudinal data analysis of multiple waves of a large, nationally representative sample of older adults to examine the relationship between volunteering and physical activity in older adults. Findings from this study on volunteer characteristics, volunteer activity, physical activity, and self-reported and other health-related variables will be used to inform the designs for experiments to determine the causal nature of the relationship between type of volunteering and level of engagement in and maintenance of physical activity with attendant health outcomes.

E. **Research Questions**

This study attempted to address gaps in our knowledge by answering the following question: What is the association between volunteering and physical activity in older adults?

Study Aim: Determine the key dimensions of volunteering that are associated with/predict physical activity in older adults within each of four waves of data and over time.

Hypothesis 1: Formal volunteering is positively associated with engagement in physical activity among older adults.

Hypothesis 2: Formal volunteering is positively associated with sustained physical activity across four waves of longitudinal data.

Hypothesis 3: Beneficial outcomes of volunteering, including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms among older adults vary as a function of the intensity (hours per year) of volunteering.

Hypothesis 4: Beneficial outcomes of volunteering, including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms among older adults are *greater* when volunteering includes a generative component, which entails working with a younger generation.

Hypothesis 5: Formal volunteering that is associated with generative role performance (volunteering with youth) will be positively associated with physical activity over four time periods.

This study had two goals. The first was to contribute to our understanding of the

relationship between volunteering and physical activity as well as motivations of older adults to volunteer. An understanding of motivation will help to identify appropriate ways to improve the recruitment and retention of older adult volunteers to maximize the impact of volunteering as a mechanism to promote physical activity in older adults.

Second, findings from this study can also be used to inform public policy on the design and implementation of physical activity initiatives that capitalize on formal volunteering as a motivator.

F. **Type of Study**

This study used a prospective, longitudinal data analysis to examine the temporal relationship between volunteering and physical activity in older adults. Longitudinal data on over 4,000 older adults in the Health and Retirement Study (HRS) revealed that older adults who volunteer are more physically active (Lum and Lightfoot, 2005; Hao, 2008; Sneed and Cohen, 2013). Studies of Experience Corps volunteers demonstrate that volunteering can be used as a mechanism to motivate older adults to engage in physical activity (Hong, Morrow-Howell, Tang, and Hinterlong, 2009; Glass et al., 2004). This study was a secondary data analysis of longitudinal data from the HRS, which regularly surveys a large, nationally representative sample of older adults.

1. **Study Strengths**

The large sample size of the HRS is one of its many strengths, allowing for confidence in population estimates of various states and conditions, including trends in volunteering and physical health outcomes (Hodes and Suzman, 2007). The survey sample size and its composition have been designed to maximize its external validity and generalizability to the U.S. population. The high overall panel response rate reduces

attrition bias. Additionally the panel design offers 11 waves of data and multiple birth cohorts allowing for studies of change and cohort trends with longer follow up periods than traditionally observed. The content of the HRS is also a strength. The survey includes a wide array of variables and new data on biomarkers and psychosocial factors, allowing for potential modeling of causal pathways to health and well-being (Sonnega et al., 2014) and the use of multiple time points allow for exploration of the temporal relationships to further probe causality. Lastly, the measures used in the HRS have been previously validated, eliminating the need to develop measures specifically for this study and are continually improved.

2. **Study Limitations**

Although the HRS has a large sample size, not all of the collected data was used due to availability limitations. Additionally, cost considerations have led to reduction in sample size of new cohorts. Sample retention is a growing issue with younger cohorts. Further, much more could be learned about the relationships between social environment and behaviors on physical activity if physical activity measurement in the HRS were improved.

Lastly, generativity is not a well-explored theory. Although a few studies have examined generativity and health, particularly with respect to physical activity, a number of qualitative studies suggest that generativity is a cornerstone of successful aging (Glass et al., 2004; Erikson, 1983; Gruenewald et al., 2012; Gruenewald et al., 2015). While the construct validity of generativity has not been well established, given the limitations of current instruments, empirical studies have demonstrated significant correlations between generativity and late life satisfaction and happiness (Glass et al., 2004; Lum and

Lightfoot, 2005). Other work examining correlations between generativity and late life activity including both volunteering and physical activity is clearly needed. It is important to note that the HRS dataset does not include an explicit measure of generativity. This limitation was addressed by using volunteer work with children as a proxy for volunteering that is motivated by generativity. This measure has not been used to examine generativity in the HRS to my knowledge. Previous studies examining generativity use the Loyola generativity scale, in which volunteering with children and work with younger generations *are* items. The Midlife in the United States (MIDUS) study also uses information about generativity as one of the dimension of well-being. The HRS plans to use MIDUS assessments tools to expand in these areas. Included are measures of multiple dimensions of psychological well-being (e.g., purpose in life, self-acceptance, mastery, personal growth, positive relations with others, autonomy), assessments of positive and negative affect, measures of adult personality development (generativity), and social responsibility (community involvements, civic engagements, volunteering) (HRS Psychosocial and Lifestyle Questionnaire, 2014).

G. **Significance**

This study will expand our knowledge and understanding of the relationship between volunteering and physical activity and potentially guide future studies exploring volunteerism as a mechanism to promote physical activity in older adults.

Physical inactivity is one of the leading causes of death, disability, and disease burden worldwide. Recent research has found that physical activity can potentially combat a genetic predisposition to sedentary behaviors (Jeste, Depp, and Vahia, 2010; Roberts, Gilpin, Knouse, Haynes, Toedbusch, Ebone, and Booth, 2012; Roberts, Brown,

Oberle, Heese, Toedebusch, Wells, and Booth, 2013; Roberts, Toedebusch, Wells, Brown, Cruthirds, Heese, and Booth, 2014) and found that the very act of being more physically active can serve as a feedback mechanism to condition the body to reinforce maintenance physical activity over time (Roberts et al., 2012; Roberts et al., 2013). The present study will enable us to test whether volunteering offers a unique opportunity for inactive or insufficiently active older adults to enhance physical activity by capitalizing on the underlying concepts of socioemotional selectivity theory and generativity.

Using the findings from the HRS data analyses this study examined the relationship between volunteering and physical activity. Specifically, this study aimed to demonstrate whether a relationship exists between formal volunteering and physical activity in older adults. The results of this study will inform potential interventions to combat physical inactivity in older adults through volunteering. The data analyses will answer the study hypotheses and determine: (1) if formal volunteering is positively associated with engagement in physical activity by older adults; (2) if formal volunteering is associated with sustained engagement in physical activity over time; (3) if the health benefits of volunteering differ based on type, intensity, and duration of volunteering and associated intensity and duration of physical activity; (4) if intensity and duration of physical activity engagement differs in older adults as a function of whether volunteering is generatively versus non-generatively motivated; and (5) if the intensity and duration of volunteering are greater when volunteering is generative in nature. These findings will hold substantial significance for the design and content of health promotion programming for older adults in the future.

H. Summary

Older adults are the fastest growing and most sedentary segment of the U.S. population. An urgent need exists to find unique and innovative ways to keep this population actively engaged in physical activity. Volunteering is a widely accepted and practiced activity among older adults, with adults over age 65 spending the most time of any age group volunteering. Examining the relationship between volunteering and physical activity is crucial to creating new ways for older adults to be physically active and can largely inform future health promotion efforts.

II. REVIEW OF RELEVANT LITERATURE

A. Introduction

This chapter provides background on characteristics of older adults who volunteer and appear to benefit from volunteering, followed by a systematic review of the relevant literature on (1) volunteering and health, (2) volunteering and physical activity (PA), and (3) theoretical perspectives of volunteering and generativity among older adults.

B. Background

1. Characteristics of Older Adult Volunteers

According to the Bureau of Labor Statistics (BLS), “older adults (OA) are more likely to participate in an organized volunteer effort if they are highly educated, have higher incomes, work at least part time, are married, and have a spouse who also volunteers” (BLS, 2012). In North America, women are more likely to volunteer than men, but men often contribute more hours when they do volunteer (Musick and Wilson, 2008). Evidence also suggests that persons who volunteered when they were younger are more likely to volunteer when they are older, and that, similarly, those who have volunteered previously will volunteer again (BLS, 2012). People who attend church regularly are more likely to volunteer and to volunteer for religious organizations when they do (BLS, 2012). The health status of older adults can also impact whether they volunteer. As they age, older adults experience an increasing number of disabilities that can be significant barriers to volunteering (Musick and Wilson, 2008). Further, an examination by Wilson and Musick (1997) of data from the Americans Changing Lives (ACL) survey found that gender, age, and health impact *informal* volunteering, such as

helping friends and neighbors, but do not impact formal volunteering.

When examining benefits of volunteering, it appears that older adults obtain health benefits regardless of race, socioeconomic status (SES), or gender (Wilson, 2000; Morrow-Howell et al., 2003; Harris and Thoresen, 2005; Barron et al., 2009; Jenkinson et al., 2013). Factors such as attending outside religious services and having more social contact outside of the volunteering experience are also noted to strengthen the relationship between volunteering and health (Harris and Thoresen, 2005; Wilson and Musick, 1997). Other studies indicate that reasons for volunteering can moderate the association between volunteering and health. Those who volunteered for self-oriented reasons, such as making new friends or feeling needed, had a mortality risk slightly lower, but similar to non-volunteers. However, those who volunteered for other reasons, such as giving back to future generations, had a decreased mortality risk, even in adjusted models.

Previous findings as well as those in the current review correspondingly indicate that benefits of volunteering have the same effects across countries among community-dwelling older adults and are not specific to race or gender. More information is needed to explore volunteerism in institutionalized older adults, as this group was not explored in the studies reviewed.

C. **Literature Search Methods**

The systematic literature search on (1) volunteering, (2) physical activity, and (3) generativity used the following inclusion criteria: scientific literature published between 1990-2015, academic databases (PsychInfo, Sociological Abstracts, PubMed, EconLit), and electronic databases of UIC library and Medline and Google Scholar Online full text

collections of publishers (Wiley Interscience, Emerald Insight, SpringerLink, Sage Journals Online, Elsevier's Scirius). These databases provide a sufficiently broad spectrum of search resources to adequately address the topic of physical activity in volunteering among older adults (OA) and are regarded as comprehensive literature search methods for health literature reviews (Cooper, 2010).

1. **Screening the Literature**

Published reviews on volunteering (and on PA, health, and OAs) were reviewed and are reported on in the summary but are not included in study tables. References cited in articles reviewed and first authors of eligible articles were also reviewed. The Interuniversity Consortium for Political and Social Research (ICPSR) at the University of Michigan and bibliographies using "volunteering" and "physical activity" as search terms were also reviewed.

2. **Inclusion Criteria and Justification**

Studies included were those published after 1990, those examining measures of volunteering and those that include PA outcomes, those that are quantitative, those written in English, those having samples comprised primarily (>50 percent) of older adults (60 and older as defined by the WHO), as well as those examining the relationship between formal volunteering and any kind of PA as an outcome. Studies that report on OAs as a subgroup were also considered if they met all other inclusion criteria. The preceding inclusion criteria yielded 10 studies that met the criteria (Table I). All 10 studies addressed volunteering and measured some sort of PA as an outcome in older adults, and two of the 10 addressed volunteering and generative fulfillment with PA in OAs. Other literature discussed is considered to be background literature related to the

TABLE I: CHARACTERISTICS OF VOLUNTEERING STUDIES

Author(s) (year)	Study Design	Sample Characteristics	PA Measured	Volunteer component (intensity, duration, type)	Study Outcomes	Study Quality
Musick, Herzog, House (1999)	Prosp cohort	POP, NR 35% volunteered n=2,348	PA, Ex, HC	VH, Vol org (0-5 in past year)	Mortality Vol orgs (.33), Vol hours (<40/>40) &PA pseudo r^2 =.20) Baseline, 3, 6, 12 yr follow up +	Moderate
Oman, Thoresen, McMahon (1999)	Prosp cohort	Pop, U OAs in Marin County, CA 32% volunteers N=1972	W, balance, chairstands, self- reported HC, Ex	Volunteerism (high/moderate/none) VH, #of vol	PH (W, balance, chairstands) pval=.001, Ex (4x/wk) p=.004, 3-5 yr follow up	Weak
Luoh, Herzog (2002)	Prosp cohort	POP, NR, Community dwelling 12% volunteered ≥100hrs 70+ yrs N=4,862	Vig PA in last 12 months 3 or more times a week	0-99 ≥100 hrs or work for charitable, religious, organization in past 12 mos	PA OR=.65, .50; p<.001, VH (>100hr) OR= .63; p<.001 Pseudo r^2 =.1874 3 -7 yr follow up	Strong
Sneed, Cohen (2013)	Prosp cohort	Pop, NR 50+ 84%NHW n=1,654	Vig or mod, AC	Formal volunteering (all types) Hr/yr	Hypertension 4 year follow up p= .04 w/PA	Strong

TABLE I: CHARACTERISTICS OF VOLUNTEERING STUDIES (continued)

Author(s) (year)	Study Design	Sample Characteristics	PA Measured	Volunteer component (intensity, duration, type)	Study Outcomes	Study Quality
Van Willigen (2000)	Retro cohort	POP, NR 39% volunteered n=2,867	W, PF, HC	VH, Vrole (0-5 orgs in past year)	Life satisfaction (ordinary least squares regression $r=.002$), VH & SRH ($r=.003$) 3 yr follow up	Moderate
Shmotkin, Blumstein, Modan (2003)	Retro cohort	Pop 10% volunteered 75-94 N=1,343	PA(rigor demanding activities, W2km), LA	Formal volunteering, type (social) Freq of formal volunteering (Several times/wk, month, year)	Activities (PA & Vol) (Y/N) OR= .96	Moderate
Harris, Thoresen (2005)	Retro cohort	Pop, NR 70+ n= 7,496 15.4% volunteered	Ex, difficulty W .25mi, AC	Never/rarely/sometimes/ Frequently in past yr	Mortality 8 yr follow up	Weak
Lum, Lightfoot (2005)	Retro cohort	Pop, NR 70+ 13% volunteered n= 7, 322	Part of SRH	0-99 or 100 hrs or more work for charitable, religious, organization in past 12 mos	SRH, Medical conditions, fxn level, mortality 7yr follow up	Moderate
Tan, Xue, Li, Carlson, Fried (2006)	RCT	Conv 60-86 yo 96% AA n=113	PA, W, Ex, LA, HC	Mentoring children K-3 ≥ 15 h/wk for academic school year	PA min, kcal ($p=.44, .52$), W ($p=.88$), Ex ($p=.11$), LA ($p=.44$), HC ($p=.07$) Base, 4, 8 month	Strong

TABLE I: CHARACTERISTICS OF VOLUNTEERING STUDIES (continued)

Author(s) (year)	Study Design	Sample Characteristics	PA Measured	Volunteer component (intensity, duration, type)	Study Outcomes	Study Quality
Barron, Tan, Yu, Song, McGill, Fried (2009)	RCT	Conv 60-86 yo 87% AA n=174	Grip strength, Wspeed, chair stand speed, stair climb speed	Mentoring children K-3 ≥ 15h/wk	SRH and W (p=.67), strength (p=.11), energy (p=.13). SRH and walk speed (p=.79), stair climb speed (p=.05), chair stand speed (p=.20), grip strength (p=.14). Baseline and at end of school year/intervention.	Strong

Note: RCT= randomized control trial; Prosp Cohort= prospective cohort study; Retro cohort= retrospective cohort study; Pop= population; NR= nationally representative; U= Unknown; PA= physical activity; PH= physical health; PF = physical function, SRH= self-rated health (good, fair, poor); WB= well-being W= walking for exercise; Ex= exercise (hiking, jogging, biking, exercise cycle, aerobics, aerobic dance, calisthenics/general exercise, swimming); LA= leisure activity (golf, bowling, dancing); HC= household chores involving PA (gardening, raking, mowing lawn); AC= active in comparison to peers; Vig= Vigorous exercise; Mod= moderate exercise; BP= blood pressure; VH= volunteer hours; p= effect size.

present study but is not included in the critical review tables and did not meet all search criteria.

D. Critical Review of the Literature

The 10 relevant primary studies were assessed for methodological quality using a coding guide created through a combination of previously established questions as well as some new questions results are shown below (Table II).

The majority of questions were from Cooper (2010). Prior to the coding, an assessment tool was used to examine study quality. The tool was developed and tested by the Effective Public Health Practice Project (EPHPP) and titled the EPHPP Quality Assessment Tool for Quantitative Studies (Appendix B) (Thomas, Ciliska, Dobbins, and Mucicci, 2004). It consists of six criteria: selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts. Intervention integrity and analyses are also part of the quality review. Reviewers rate each criterion as “weak,” “moderate,” or “strong,” and then a final global rating is determined for each study. The tool has demonstrated reliability, content and construct validity, and the ability to adapt current methods for systematic literature reviews of effectiveness to questions related to public health (Cancelliere, Cassidy, Ammendolia, Côté, 2011). The tool is easy to use and comes with a dictionary to clarify any questions. In-depth reviews for each study were performed.

1. Data Extraction and Synthesis

All rated studies were included (ranging from weak to strong) given the limited selection of studies and the importance of recognizing and discussing the clinical significance of even non-statistically significant increases in physical activity.

TABLE II: CRITICAL APPRAISAL OF EACH STUDY/ QUALITY ASSESSMENT (EPHPP TOOL)

Study Name	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Integrity	Analyses
Volunteering and Mortality Among Older Adults: Findings From a National Sample	NR, POP	Prosp cohort	Sociodemographics, health status and activity, physical activity, social integration	N/A	Interviewer administered questionnaire, previously validated, ACL survey	50% FU for all 3 waves	N/A	Cox proportional hazards regression
Volunteerism and Mortality among the Community-dwelling Elderly	Marin County, California OAs (not representative)	Prosp cohort	Demographics, health status, physical functioning, health habits, social support, religious involvement, and emotional states	N/A	Self-report survey, FU at 3-5 years for interview and testing, validated measures for depression scale, social scale	3% attrition	N/A	Individual level of analysis, 2 tailed pearson chi squared
Individual Consequences of Volunteer and Paid Work in Old Age: Health and Mortality	NR POP long survey OAs	Prosp cohort	Sociodemographics, health status	N/A	AHEAD long study, self-report	20% non-response	N/A	Individual level of analysis Logistic regression

TABLE II: CRITICAL APPRAISAL OF EACH STUDY/ QUALITY ASSESSMENT (EPHPP TOOL) (continued)

Study Name	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Integrity	Analyses
A Prospective Study of Volunteerism and Hypertension Risk in Older Adults	Nationally representative sample	Prospective cohort	Controlled for standard control variables and examined potential mediators	N/A	Multiple Validated scales, self-report, HRS survey	Baseline and follow up for all subjects included	N/A	Individual unit, Linear regression, multiple regression models
Differential Benefits of Volunteering Across the Life Course	Nationally rep sample, POP	Retro cohort	Age, black, female, fxnl impairment, married, dependent children, SES, economic strain, informal social integration, religious services, social support, mastery	N/A	Self-report health by interviewer administered questionnaire	21% Attrition	N/A	Hierarchical, Cox proportional hazards analyses, multiple models
Beyond Keeping Active: Concomitants of Being a Volunteer in Old-Old Age	Representative of POP in Israel but not generalizable to U.S. residents	Retro cohort	Sociodemographics, activity outlets, functioning markers	N/A	Self-respondents interviewed, Cross-Sectional and Longitudinal Analysis Aging Study (CALAS)	32% attrition	N/A	Logistic regression, Cox proportional hazard regression

Study Name	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Integrity	Analyses
Volunteering is Associated with Delayed Mortality in Older People: Analysis of the Longitudinal Study of Aging	Representative sample	Retro cohort	Controlled for demographic and health characteristics	N/A	LSOA, Self-report, validated	38% sample deceased before 96 month FU	N/A	Hierarchical, Cox proportional hazards, multiple models
The Effects of Volunteering on the Physical and Mental Health of Older People	Representative sample	Retro cohort	Controlled for demographics, marital status, SES < baseline health and functioning	N/A	AHEAD self-report survey, use previously validated scales	Low attrition rate (8.3% during this 7 yr period)		Individ level Weighted data, multinomial logit regression (DV was nominal)
Potential for Intensive Volunteering to Promote the Health of Older Adults in Fair Health	Sample is rep of target pop, 96% AA	RCT	Socio dem, PA and activity level	No	Self-report health and fxnl status, validated surveys, standardized interviewer administered questionnaires and performance-based testing	13% drop out	Delayed control	Individual level, multivariate linear regression, ANOVA, Chi square

Study Name	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Integrity	Analyses
Volunteering: A Physical Activity Intervention for Older Adults-The Experience Corps Program in Baltimore	Sample is rep of target pop, 96% AA	RCT	Sociodem, health, mobility disability, frailty	No	MLTAQ validated, doesn't measure PA related to Volunteering, self-report	13% drop out	Delayed control all offered intervention, unintended intervention ?	Individual level, multivariate linear regression

Appendix B summarizes and details the criteria for each rating classification (Thomas et al., 2004). Information was extracted from each study on (1) study design, (2) sample characteristics, (3) PA measurement, (4) inclusion and exclusion criteria, (5) volunteer component, (6) outcome measurements and follow up periods, and (7) study quality (including limitations).

This literature review yielded 10 studies (Table II), including four retrospective, four prospective cohort studies, and two RCTs relying on convenience samples. To date, the two RCTs emanate from a single study that directly assessed the impact of volunteering on physical activity in older adult volunteers. This study was conducted in 2006 to assess the impact of the Experience Corps implemented in Baltimore, Maryland (Tan, 2006; Tan et al., 2009). The RCT assessed the impact of a participation in the Experience Corps to generate social benefits while simultaneously offering a community-based approach to health promotion. Participants were randomized to an intervention group or a wait list control. Intervention group participants volunteered at least 15 hours per week in elementary schools and assisted children with academic achievement (reading, library support, classroom behavior, etc.) during the academic year. The Experience Corps studies were the only RCT volunteer studies that reported outcomes of volunteering inspired by generativity as well as physical activity (Tan, 2006; Tan et al., 2009; Gruenewald et al., 2015).

The majority of the studies identified by the literature search were secondary data analyses of nationally representative longitudinal data sets with only two being reports from RCTs of a single intervention, Experience Corps. Subjects in most studies ranged in age from 50 to 89 years and were predominately female with sample sizes ranging from

113 to 8,222 subjects. Overall, attention to bias affecting internal validity was the weakest aspect of the studies. Neither of the RCT studies used blinding to treatment or adjusted for exposure to the intervention, and both relied upon self-reported data. Few of the studies reported the specific type of volunteering engaged in or indicated whether the volunteering encompassed a social component, and only two (from the Experience Corps RCT) indicated whether the volunteering included a generative component. Every study reported the frequency of volunteering but they used different time frames to categorize it. Volunteering was not categorized by type in any of the studies, but information was extrapolated based on the intervention components that were described in some of the studies. Physical activity was not measured consistently across the studies, ranging from quantified organized exercise time (e.g., hours per week) to self-reported activity levels (e.g., moderately active, very active). Given the inconsistent and variable nature of this existing literature on volunteering and physical activity, future studies should directly examine this relationship using agreed upon, consistent definitions.

E. **Results**

1. **Volunteering and Health**

a. **Morbidity and Mortality**

Although the relationship between volunteering and physical activity is under- and inconsistently explored in these 10 studies, findings on the relationship between volunteering and health demonstrate a consistent connection between volunteering and lower levels of morbidity and mortality. The prospective study of 1,972 older residents in California by Oman, Thoresen, and McMahon (1999) found that over a period of three to six years, those who volunteered for two or more

organizations had a 63 percent lower mortality rate than non-volunteers. The Asset and Health Dynamics among the Oldest Old study (AHEAD), part of the Health and Retirement Study (HRS), and the Longitudinal Study of Aging (LSOA) examined the health and mortality of older adult volunteers over seven- and eight-year periods, respectively. The AHEAD studies found that older adults who volunteered at least 100 hours per year were significantly less likely to report poor health and limitations in activities of daily living, as did findings from the Americans Changing Lives data set (Musick, Herzog, and House, 1999; Luoh and Herzog, 2002), and two years later it was found that high volume volunteers had significantly lower mortality than both non-volunteers and volunteers who invested fewer than 100 hours (Luoh and Herzog, 2002; Lum and Lightfoot, 2005). A retrospective cohort study on a national sample of the Israeli Jewish population by Shmotkin, Blumstein, and Modan (2003) found that volunteers had a significant 33 percent reduction in mortality risk compared to non-volunteers (with a reported HR=0.67) over a five- to eight-year period (interviewed 1989-1992 and followed up 1997). Similarly, in the United States, when examining the LSOA, Harris and Thoreson (2005) found a relationship between volunteering and reduced mortality in older adults at 96-month (eight year) follow up. They found that compared to individuals who never volunteered, those who rarely volunteered had a 41 percent reduction in mortality risk ($p < .05$), those who sometimes volunteered had a 42 percent reduction in risk ($p < .001$) and those who frequently volunteered had a 53 percent reduction in mortality risk ($p < .001$). Interestingly, when physical activity variables were included as covariates, compared to people who never volunteered, those who rarely volunteered had no significant reduction in mortality risk, those who sometimes

volunteered had a 23 percent reduction in mortality risk ($p < .05$) and those who frequently volunteered had a 31 percent reduction in mortality risk ($p < .001$), leading the authors to speculate that the volunteering-mortality relationship may be mediated by physical activity.

b. **Hypertension**

Findings from these 10 studies of volunteerism and health are inconsistent with respect to the level of commitment that is needed to obtain benefits. As cited in Sneed and Cohen (2013), Burr, Tavares, and Mutchler (2011) found that people who volunteer 100 hours a year or more were less likely to be hypertensive. However, in their longitudinal study using data from the HRS on 6,734 individuals over four years, Sneed and Cohen (2013) found no association between volunteerism and hypertension risk at lower levels of volunteer participation. Volunteering at least 200 hours was associated with greater increase in physical activity compared with non-volunteers, but the authors could not explain the lack of an association between low intensity volunteerism and hypertension risk. The difference in findings is likely due to the fact that some studies do not distinguish between persons who volunteered 100 to 199 hours versus 200+ hours, but instead collapse them into a single measure of volunteer hours (>100 hrs per year or <100 hrs per year). When Sneed and Cohen compared high versus lower volume volunteers they found that those who volunteer 200 hours or more per year (roughly four hours per week) were 40 percent less likely to develop hypertension over the four-year follow up. Significant risk reduction was observed only in those who met this volume/dose criterion (Sneed and Cohen, 2013).

c. **Self-Rated Health**

An RCT by Tan and colleagues (2006) on 113 volunteers participating in the Baltimore Experience Corps found that at four- and eight-month follow up, volunteering enhanced self-rated physical health and decreased functional dependency among Americans aged 60 and above, but had no effect on chronic health conditions (Tan, 2006). A follow up report from the same RCT and study team (Barron, Tan, Yu, Gong, McGill, and Fried, 2009) also found that at four to eight months volunteers reported increased strength and energy and those who reported their health as “fair” were significantly more likely to display improved stair climbing speed than those in good, excellent, or very good health (100 percent versus 53.4 percent versus 37.5 percent at $p=.05$ respectively).

d. **Life Satisfaction**

Using nationally representative longitudinal data on 3,617 adults (of whom only 278 were over age 60), Van Willigen (2000) found that older volunteers experienced greater increases in life satisfaction over a period of three years as a result of engaging in more volunteer hours than younger adults, and older adults who did not volunteer reported significantly worse health than their volunteering counterparts.

e. **Physical Activity**

In their prospective study of 1,972 California seniors, Oman and colleagues found that across three levels of volunteerism (high, moderate, none) higher levels of volunteerism were associated with more physical activity over a period of three to 5.6 years (Oman et al., 1999). Similarly, in their study of volunteering among Israeli Jews 70 and older, Shmotkin and colleagues (2003) found that when examining all other activity outlets (physical activity, volunteering, a hobby, and every day activities), only

physical activity maintained a significant association with volunteering and reduced mortality risk. Tan and colleagues tested these findings in their 2006 RCT with Experience Corps Volunteers and found that volunteering led to increased physical activity in older adults; however, since the study was a pilot, it lacked adequate statistical power. Also, because the study population was 96 percent African American it was difficult to generalize the findings to other populations. Tan and colleagues also measured change in physical activity from baseline to follow up but failed to quantitatively assess the amount of physical activity that likely occurred *due* to the volunteer program by controlling for baseline physical activity.

While examining whether volunteerism is prospectively associated with hypertension risk among older adults, Sneed and Cohen (2013) found that volunteering was associated with increases in physical activity that resulted in reduced hypertension risk. Individuals who reported volunteering at least 200 hours in the last 12 months prior to baseline reported greater increases in PA than non-volunteers (Sneed et al., 2013). Findings from several of the 10 studies reviewed suggest that the effect of volunteering on mortality and other health outcomes may be mediated by physical activity or that, conversely, volunteering may be a proxy for better health, activity level, or demographic variables associated with mortality (Musick, Herzog, and House, 1999; Harris and Thoresen, 2005). Additionally, among the 10 studies reviewed, when physical activity was controlled for, the correlation between volunteering and health outcomes was not as strong as when physical activity was not controlled for, indicating that physical activity could be either a moderator or a mediator in the relationship between volunteering and health or mortality risk in older adults. Because the role of PA as either a moderator or

mediator was not directly explored in any of the studies, its role should be explored in the future. Further, several studies found that PA had strong and statistically significant effects on health and mortality among volunteers, and higher levels of PA were associated with lower mortality rates (Van Willigan, 2000; Luoh and Herzog, 2002; Harris and Thoresen, 2005; Lum and Lightfoot, 2005; Sneed and Cohen, 2013).

2. **Intensity and Duration of Volunteering**

A retrospective cohort study on 2,867 respondents examining volunteer intensity using two waves of data from the Americans Changing Lives (ACL) survey found that improvements in health were associated with increased number of volunteer hours and that older adults experienced greater increases in life satisfaction and greater positive changes in perceived health than did younger volunteers (Van Willigen, 2000). Morrow-Howell and colleagues reported similar findings from a secondary data analysis of three waves of data from the ACL on 1,669 adults aged 60 and older over an eight-year period. They found that older adults who volunteered and engaged in more hours of volunteering reported statistically significant higher levels of well-being on three independent measures: functional dependency, self-reported health, and depression. They found no effect for the number of organizations for which the older adult volunteered and interestingly, neither the type of organization, nor the perceived benefit of the work to others seemed to impact the independent measures (Morrow-Howell et al., 2003).

Subsequent findings on the intensity and duration of volunteering are inconsistent with the earlier findings in the literature. A recent systematic review and meta-analysis on volunteering by Jenkinson (2013) found that regardless of hours, health benefits were associated with sustained versus intermittent volunteering. Overall however, studies

consistently report that older adults who both volunteer and devote more hours to volunteering report higher levels of well-being than non-volunteers (Luoh and Herzog, 2003; Morrow-Howell et al., 2003; Harris and Thoresen, 2005; Lum and Lightfoot, 2005).

3. **Threshold for Volunteering**

Early work from Van Willigen (2000) and Luoh and Herzog (2005) confirmed by Cohen (2013) found that after a certain number of volunteer hours per year (100 in one study, 140 in another), the physical benefits, measured in self-reported physical health, of volunteering among older adults begin to decrease. These findings directly contradict findings from the Experience Corps RCT that demonstrate that even at greater than 400 hours a year volunteers reported better health and physical activity (Tan et al., 2006). The existence of this type of threshold and the notable discrepancy in reported findings of the intensity of volunteering that benefits older adults further justify the need for examining these outcomes in the current study.

4. **Maintenance of Volunteering**

The literature remains unclear about which forms of volunteering are best suited to maintenance given the limited information on types of volunteering in the longitudinal data analyses included in this review. However, in the Experience Corps trial those who volunteered to work with children maintained physical activity at eight-month follow up and increased the number of blocks walked, stairs climbed, and gait speed independent of their hours as a volunteer and even when volunteer obligations ceased, implying that volunteering with children could be a mechanism for sustained physical activity (Tan, 2006).

5. **Theoretical Perspectives of Volunteering**

Several theories spanning different perspectives are associated with volunteering, including theories about what motivates adults to volunteer, what kinds of people are more likely to volunteer, what types of volunteering benefit which populations, and many more. Although several theoretical and conceptual models have been used to study volunteerism, currently there is no single or integrated model or theory for volunteering (Hustinx, Cnaan and Handy, 2010). The lack of a single integrated theory in part is explained by the fact that volunteering encompasses such a vast array of activities that it would be impossible for a single theory to include all forms and methods of volunteering. Motivation to volunteer (MTV) is a well-researched topic and offers valuable insight into why people volunteer as well as what kinds of people volunteer (Wilson, 2000) and has played a valuable role in the recruitment and retention of volunteers. Prior research gives clear insight into types of people most likely to volunteer but does not explain who is most likely to benefit from different kinds of volunteering. Some prior research has suggested that older adults are most likely to benefit from volunteering for others and that older adults will, over their lifetimes, develop a need to give back as they become older. Exchange theory and social capital convey a similar message about shifts in volunteer priorities as adults age. These findings are supported also by the socioemotional selectivity theory (SST) and generativity.

a. **Socioemotional Selectivity Theory**

SST posits that aging transforms an individual's priorities for goals and motivations in that priorities change from knowledge-related goals (understanding) to emotionally meaningful goals (values or social). As older adults progress through the life

course they tend to have more “present-oriented” goals related to emotional fulfillment, such as the pleasure of knowing they are needed and engaged in socially meaningful activities (Carstensen, 1992).

b. **Generativity**

Generativity, as defined by Erickson, is concerned with the idea of giving back to younger generations later in life. In general, the literature shows that generativity is linked to reduced risk of mortality, better cognitive and physical functioning, and greater levels of well-being in older adulthood (Gottlieb and Gillespie, 2008). Generativity that is expressed in the form of volunteering is associated with delayed mortality (Morrow-Howell, Hinterlong, Rozario, and Tang, 2003; Harris and Thorensen, 2005; Martinson and Minkler, 2006; Konrath, Fuhrel, Lou, and Brown, 2012; Gruenewald et al., 2015). Gruenewald and colleagues (2015) also note that perceptions of generativity may be connected to physical health outcomes in that volunteers who feel generative and are able to engage in generative role performance, may have better health outcomes. They note that two mechanisms explain the impact of the behavior on outcomes: (a) with respect to health-related behavior, those who feel more generative may take better care of themselves to maintain their ability to contribute, and (b) with respect to social and productive engagement, these same individuals will be more likely to engage in more social and productive activity, which all seem to be paths to better physical well-being. Another RCT study on levels of generativity in 352 Experience Corp volunteers (versus other volunteer opportunities) found that greater perceptions of generativity at baseline predicted significantly lower odds of increased ADL disability or mortality over the two-year follow up period (Gruenewald et al., 2015). Additionally,

older adults in their 60s and 70s with greater self-perceptions of generativity were less likely to experience increases in ADL disability or to die as they aged into their 70s and 80s (Gruenewald et al., 2015). These findings are consistent with previous research linking generativity and decreased disability and mortality in older adults (Grand et al., 1988, 1990; Gruenewald et al., 2007, 2009; Okamoto and Tankaka, 2004; Pitkala et al., 2004). Empirical evidence of generativity theory is scarce, which is a limitation to use of this theory and necessitates finding support from socioemotional selectivity theory, which is much more widely used and supported to demonstrate reasons older adults may become engaged in and benefit from volunteering.

Results from another Experience Corps RCT by Gruenewald and colleagues demonstrated that the experimental group had significantly higher levels of generative desire and perceptions of generative achievement than controls who performed non-intergenerational volunteering, and that these results were sustained at 12 and 24 months (Gruenewald et al., 2015). The findings demonstrate that intergenerational volunteering can lead to increased feelings of generativity in older adulthood. Although the reasons are not entirely clear in all studies, it seems that generative role performance may contribute to improved perceptions of generativity and increased self-care, physical activity, and maintenance of physical health (Wheeler et al., 1998; Lum and Lightfoot, 2005; Tan, Xue, Li, Carlson, and Fried, 2006; Gruenewald et al., 2015).

The Wisconsin Longitudinal Study examined the effects of motives for volunteering on older adult respondents' mortality risk four years later, and found that respondents who listed social connection or altruistic values as their predominant motives were significantly less likely to have died four years later compared with non-volunteers

(Konrath, Fuhrel-Forbis, Lou, and Brown, 2011). These findings are consistent with the literature on generativity, which indicates that older adults who are motivated by a desire to give back are more likely to obtain health benefits from volunteering, and that type of volunteer activity—specifically, presence of a generative motive—can mediate the impact of volunteering on health (Gruenewald, Liao, and Seeman, 2012; Gruenewald et al., 2015).

Although type of volunteer work could mediate the volunteer health/ physical activity relationship, to date, limited research has been done to expressly examine which volunteer activities benefit the volunteers most. Prior research has demonstrated that older adult volunteers have a higher quality of life than non-volunteers. A meta-analysis of 37 studies on volunteering found that volunteering with components of social interaction provide greater health impact than administrative or isolated work (Wheeler, Gorey, and Goldenblatt, 1998). Another review examining the relationship between volunteering and health among older people cites social capital as a mechanism for supporting and maintaining health in older persons as well as for providing informal support in times of sickness and stress (Onyx and Warburton, 2003). A review of Baby Boomers who volunteer by Rozario (2006) cites beneficial effects of volunteering including social capital, self-esteem, and self-reported health (Rozario, 2006). A review of volunteerism, health, and civic engagement among older adults found that volunteers may enjoy good health and longevity because being useful to others instills a sense of being needed and valued (Gottlieb and Gillespie, 2008). Gruenewald, Liao, and Seeman (2012) take this one step further and cite generative desire fulfillment as the cause of this good health, stating that “those who felt more generative had more frequent social

contact, provided more support to others, volunteered more, were more physically active” (p. 3).

Findings from the Experience Corps RCT (Tan et al., 2003), indicate that presence of a generative component leads to increased physical activity through volunteering. However, more specific-measures are needed to clearly identify what types of volunteering mediate the relationship between volunteering and physical activity as well as the strength of this mechanism with respect to level and duration of physical activity over time.

6. **Limitations**

There were some crosscutting limitations associated with the 10 studies reviewed. Cross-sectional studies are limited in that it is not possible to identify causal direction to the associate between volunteering and physical activity, so while the studies by Shmotkin et al., 2003, and Oman et al., 1999, are compelling and contribute to the current literature they do not provide a clear understanding of the directionality of the relationship between volunteering and physical activity. It is equally plausible that those who are more physically active are more likely to volunteer and that those who are more sedentary and less physically active are also less likely to partake in formal volunteer activities. The longitudinal studies show that some of the effects of volunteering on health outcomes were moderated by variables such as physical activity, and the strength of the relationship decreases when they are controlled; however the studies did not measure directly the relationship between volunteering and physical activity.

There are also limitations to the theories, as discussed in Chapter 1. While generativity theory is consistent with other theories and across studies, using generativity

is not well supported by many independent studies and is to date relatively under explored.

7. **Implications for Research**

Future research priorities should directly examine the relationship between volunteering and subsequent physical activity levels in older adults. Future studies should be able to clearly identify the intensity and duration of volunteering required to obtain physical activity benefits and meet daily physical activity requirements such that a prescription of volunteering might be possible.

Once the intensity and duration as well as the directionality and strength of the relationship between volunteering and physical activity and potential mediators thereof are known, policy aimed at promoting volunteering for health in current and future cohorts of older adults could ensue with beneficial effects. These policies could encourage a volunteer work force to act as a health promotion strategy for older adults, simultaneously contributing to successful aging and to our economy. Physicians could also begin to prescribe volunteering to promote healthy aging in older adults (Hirschfelder and Reilly, 2007). Making volunteer activity part of a prescriptive regimen for older adults before they retire could help older adults to adhere to this activity after they retire and to maintain the activity as long as they are physically able. The current boom in the population of older adults can be viewed as a great opportunity for an unpaid volunteer work force. The Baby Boomers are notably more civically engaged than any other generation and are also more likely to be working into later ages (Gottlieb and Gillespie, 2008). This trait gives them an opportunity to merge two desires of civic engagement through volunteering and continued “working” by giving back to younger

generations, while also helping the economy and sustaining relationships with other volunteers (motivated peers) and younger adults if they so desire. “Before and after” studies in the United Kingdom (O’Brien, Townsend, and Ebdon, 2010) and the United States (Yuen et al., 2008) confirm that even small amounts of volunteer work can improve mental health, although longitudinal analysis is needed to assess long-term effects. Thus an urgent research priority is longitudinal data analysis that can directly test these relationships, followed by designing and testing interventions that implement the findings into evidence-based interventions to promote and sustain volunteering.

F. **Conclusion**

This literature review yielded four retrospective cohort studies, four prospective cohort studies, and two RCTs. The RCTs presented findings from the same intervention and relied on convenience samples. To date only one RCT—the Experience Corps trial—has directly assessed the impact of volunteering on physical activity among older adult volunteers. These findings highlight a gap in the literature with respect to the number and quality of longitudinal and methodologically rigorous studies that have examined the relationship between volunteering and physical activity.

Importantly, all of the studies reviewed indicate that a relationship exists between volunteering, physical activity, and delayed mortality. In some studies the association is clearer, in some physical activity is identified as a moderator, while others suggest physical activity may mediate the relationship between volunteering and health and mortality. Given the cross-sectional nature of many studies published it is impossible to infer causality and in some cases difficult to determine directionality. Though many studies used survey data from longitudinal studies, their secondary analyses are cross-

sectional or correlational but do not utilize the breadth and depth of the longitudinal data provided. More research is needed that specifically focuses on physical activity in relation to different intensities of volunteering to determine whether volunteering of specific types in fact leads to increased physical activity in older adults. The curvilinear relationship identified in several of the studies between volunteering and health also needs to be further explored to ensure promotion of health and well-being in older adult volunteers.

The findings of this review support the hypothesis that engagement in volunteer activities positively affects older adults and in certain cases impacts physical activity outcomes. Studies using large longitudinal data sets to examine temporal relationships as well as prospective studies examining volunteering as a predictor for health outcomes suggest that volunteering is associated with decreased morbidity and mortality and greater physical functioning, even after controlling for relevant covariates. These findings imply that volunteering is not simply a proxy for other factors that are known to affect health outcomes, such as physical activity or social engagement. Overall this body of literature indicates that volunteering may be associated with physical activity. Furthermore, volunteering appears to be an independent predictor of physical activity after multiple covariates including demographics, social support and involvement, health behaviors, and medical health status are controlled for. Future research should be directed at definitively assessing these hypothesized relationships using longitudinal data to assess their directionality. Once the nature of these relationships is understood, findings can be used to design and test interventions to improve participation in volunteering among older adults.

III. RESEARCH DESIGN AND METHODOLOGY

Chapter 2 reviewed the relevant literature on physical activity and volunteering highlighting current gaps in knowledge of the relationships between these topics. Research to date is inconclusive regarding the impact of volunteering on the physical activity levels of older adults. This chapter describes the methodology used to further examine this issue.

A. Study Design

This study used longitudinal data from the Health and Retirement Study (HRS), a large, nationally representative sample of older adults in the United States. The purpose of this study was to examine the relationship between volunteering and physical activity in older adults. Prior work has demonstrated that the HRS is a valuable tool for assessing relationships among health, leisure activity, volunteering, retirement, healthcare spending, physical activity, and other important aspects of aging over time and can be used to provide information that will help address the challenges and opportunities of an aging population (Juster and Suzman, 1995; Lum and Lightfoot, 2005; Castora-Binkley, Peronto, Edwards and Small, 2013).

B. Data Source – The Health and Retirement Study

This study used a sample of N=8,228 respondents who completed surveys in four waves of data collection (2008, 2010, 2012, 2014) on volunteering, physical activity, health, and demographic information collected in the HRS. The HRS is a nationally representative longitudinal panel survey of more than 37,000 individuals age 50 and older in 23,000 households in the United States. The HRS survey has been conducted every

two years since 1992 by the University of Michigan Institute for Social Research (ISR) and the National Institute on Aging (NIA) (Juster and Suzman, 1995; Sonnega et al., 2014). The survey was designed to be a national resource for data on the changing health and economic circumstances, occupations and employment, health care, living and housing arrangements, and demographics and family relationships associated with aging at both individual and population levels (Sonnega et al., 2014). HRS data have been used to study individual aging and to analyze national trends in health and economic status over time (Sonnega et al., 2014). The data in the survey are linked at the individual level to other information such as Social Security, Medicare, Veteran's Administration, the National Death Index, and employer-provided pension plan information (Sonnega et al., 2014). Since 2006, data collection for the survey has expanded to include biomarkers and genetics as well as expanded psychology and social context information. The depth and breadth of this information provides an unmatched opportunity to study complex relationships and events related to aging and can be used to explore causality, examine relationships, inform research, design experiments, and inform policy (Sonnega et al., 2014).

C. **Study Sample and Selection of Data Sets**

The target population for this analysis was adults 50 and over who completed a combination of the 2008, 2010, 2012 and 2014 CORE HRS surveys. The HRS uses a multistage probability sample design. Interviews are completed by phone and in person with off-year surveys completed by mail. The CORE survey is the main survey that makes up the HRS. The CORE survey and the leave behind portion of the CORE encompass all of the variables of interest in this study. The CORE survey is the main

survey that has been implemented every two years since 1992. The survey has changed over the years but for the most part has contained or now contains information on demographics and background, health, cognition, family structure and transfers, functional limitations, housing, physical measures, employment and pensions, disability, health services and insurance, expectations, assets and income, asset change, widowhood and divorce, wills, insurance trusts, and beneficiaries (Sonnega et al., 2014). The Leave-Behind (LB) Questionnaire on psychosocial topics includes questions on participation in general activities, relationships with others, and views on life in general as well as on specific aspects of life. The sample selected by the HRS for the LB is a randomly preselected one-half of households, with the other half eligible in the subsequent wave. The LB questionnaire is a self-administered questionnaire left behind at the end of the CORE as part of an Enhanced Face to Face (EFTF) interview. Since 2006, participants have self-reported on life circumstances, subjective well-being, lifestyle, and stress through the LB questionnaire. The LB psychosocial questionnaire provides valuable information on social relationships (spouse/child/kin, loneliness, friend contact), self-related beliefs (personal mastery [control], perceived constraints, domain-specific control, hopelessness, subjective age, self-perceptions of aging, subjective social status, optimism/pessimism, need for cognition), and lifestyle activities (including religiosity, discrimination, and stressful life events) (Sonnega et al., 2014).

The LB questionnaire is used for psychosocial information on volunteers and non-volunteers. The 2008 response rate for the LB was just under 89 percent among those who completed the EFTF. Among all those assigned to the enhanced interview who completed any sort of interview, the response rate was about 80 percent. Factoring in the

2008 core response rate of 88.4 percent for those assigned to EFTF, the overall response rate for the LB was about 71 percent (Smith et al., 2013). The overall response rates for the CORE have declined over time, following the national trend, but remain relatively high. This is in part because the HRS staff makes every effort to ensure participation at each wave and even if participants cannot be reached at one wave they are contacted at the next (Sonnega et al., 2014).

HRS data now include six cohorts with varying baseline years: HRS cohort (born 1931-1941, baseline 1992), AHEAD cohort (born before 1924 sampled for the Study of Assets and Health Dynamics Among the Oldest Old, baseline 1993), Children of Depression cohort (born 1924 to 1930, baseline 1998), War Baby cohort (born 1942-1947, baseline 1998), Early Baby Boomer cohort (born 1948-1953, baseline 2004), and Mid Baby Boomer cohort (born 1954-1959, baseline 2010) (Health and Retirement Survey Data Description and Usage, 2014). The present study included all cohorts except the Mid Baby Boomer Cohort to ensure continuity of variables and complete data for as many participants as possible. This study used CORE data and corresponding LB data from the 2008, 2010, 2012 and 2014 waves. Using these data enabled analysis of at least four waves of data from five of the six cohorts, allowing for maximum sample size and an examination of the behaviors reported by each of these cohorts. Data from waves nine to 12 (2008–2014) also corresponded to the most recent subsequent waves with identical, and thus directly comparable measurements of physical activity across waves. The HRS collaborates with the RAND company to produce RAND data files of the HRS that are a cleaned, user friendly, and streamlined version of the HRS with variables covering most measures that are named consistently and intuitively across waves. The RAND data also

include model-based imputations and information on spouses for most individual level variables (St. Claire, Blake, Bugliari, Chien, Hayden, Hurd, ... and Zissimopoulos, 2002; Nowell, 2014; RAND, 2014). The RAND files include imputations for income, assets, and medical expenditures developed at RAND. The RAND data are continually updated, developed, and improved. Most demographic and health variables used in this study are from the RAND version O files. Data for primary dependent variables (physical activity) and predictor variables (volunteering), however, are from 2008, 2010, 2012, and 2014 HRS CORE files. The RAND version O file does not include the 2014 data released by HRS, so some secondary outcome variables including functional status and physical (e.g., balance tests, timed walk tests) measures are from the RAND version O file with others being from the latter 2014 HRS CORE files. Data files from RAND and the HRS were merged to ensure both the most up to date and cleanest forms of participant data are used. The 2014 RAND Tracker file provided demographic variables necessary to accurately merge RAND data sets and HRS data sets, and codebooks were used to assist with data management (Servais, 2004; Servais, 2010). Time-invariant covariates including birth year, race, and education level were obtained from the respondent's baseline interview wave. Time-varying covariates including age, household income, employment status, and perceived health status were extracted from each of the four data waves where available. For chronic conditions, depressive scores and functional limitations data were from waves 2008, 2010 and 2012.

1. **Target Population of the Health and Retirement Study**

Respondents at least 50 years of age who were not missing self-report data on volunteer and physical activity at 2008, 2010, 2012, and 2014 time points were

eligible for inclusion in these analyses. One member of each household was randomly selected for inclusion in the final sample to avoid confounding from unmeasured household-level variables (N=8,228).

The following paragraphs provide more detail about the interviews that were used for this study and specify the content used from each wave. See Figures 2 and 3 for a brief overview of this information.

The 2008 data file is a merged file consisting of information from the CORE questionnaire administered in February of 2008 through February of 2009. There were 17,217 respondents who completed the interview. The file also contains responses from the 2008 LB questionnaire and the RAND O data file. Data on baseline physical activity and items on volunteering are from a merged 2008 core file that also contains responses from the 2008 leave behind, and the demographic and baseline health information from the RAND O file.

The 2010 data file is a merged file containing both the HRS/LB responses from the 2010 wave and the RAND O data.

The 2012 data file is a merged file containing both the HRS/LB responses from the 2012 wave and the RAND O data file.

The 2014 data file contains information from the 2014 HRS CORE survey and the subsequent leave behind survey of that wave. No RAND data are used in the 2014 data set because the 2014 RAND data set has not been released. The 2014 data file is a merged file containing respondent level data files from sections A, B, C, G, I, M, and LB.

D. **Measures**

Figure 2: Data sets and measures used for analysis

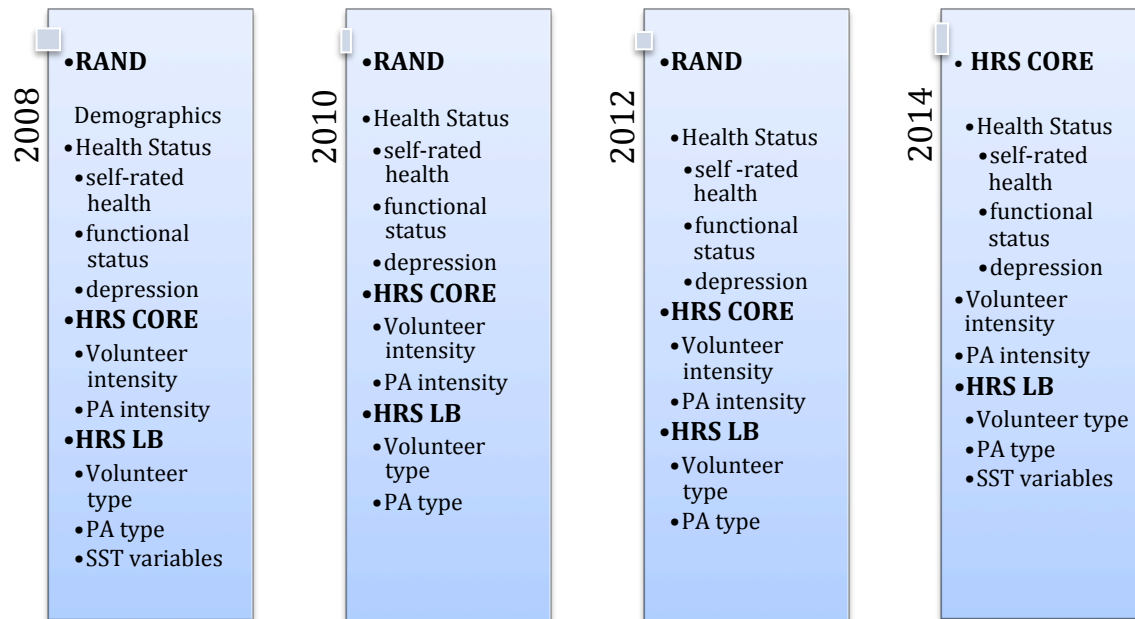
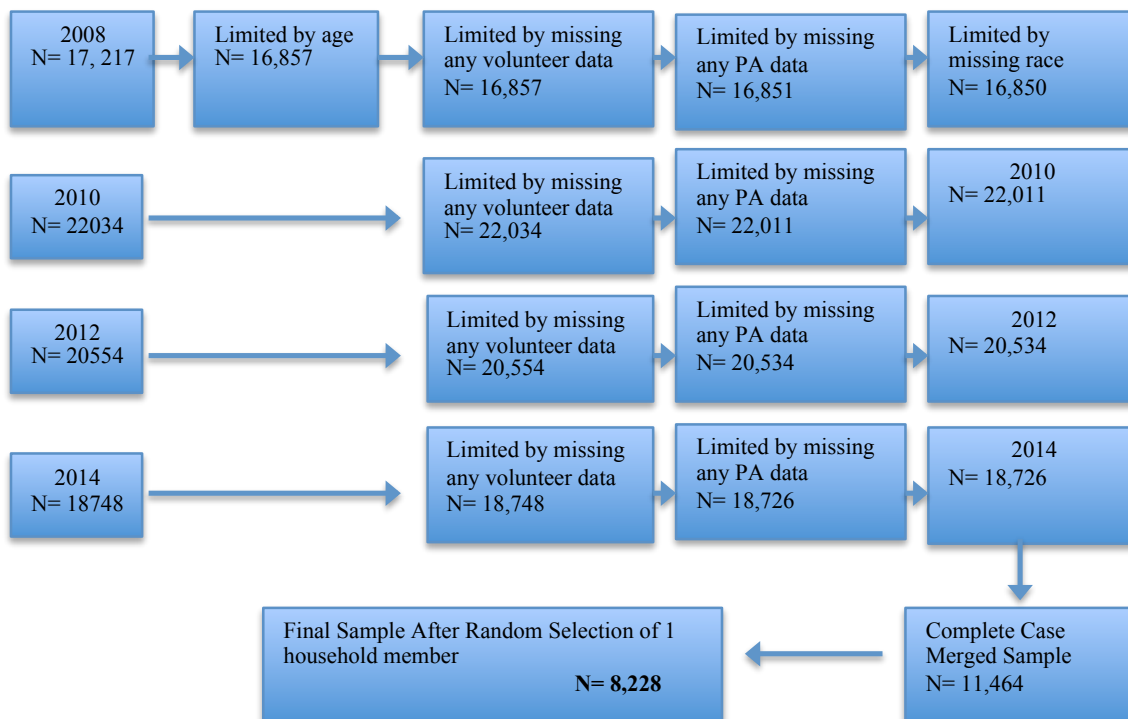


Figure 3: Overview of study sample



A complete codebook of all variables used in this study along with the wave from which each item originated, exact item wording, and response options is presented in Table XII, Appendix C.

1. **Dependent Measures**

The primary outcome of interest in this study was physical activity (PA). The HRS asks about respondent PA behaviors using three categorical items in the CORE and in two additional ways in the leave behind. In the CORE, respondents are asked the following questions to assess their participation in vigorous, moderate, and mild types of physical activity:

"We would like to know the type and amount of physical activity involved in your daily life. How often do you take part in sports or activities that are vigorous, such as running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel: more than once a week, once a week, one to three times a month, or hardly ever or never?"

"And how often do you take part in sports or activities that are moderately energetic, such as gardening, cleaning the car, walking at a moderate pace, dancing, floor or stretching exercises: more than once a week, once a week, one to three times a month, or hardly ever or never?"

"And how often do you take part in sports or activities that are mildly energetic, such as vacuuming, laundry, home repairs: more than once a week, once a week, one to three times a month, or hardly ever or never?"

Respondents are given the five response categories of more than once a week, once a week, one to three times a month, hardly ever, or never, or permitted to volunteer an answer of “every day.”

In the leave behind physical activity is ascertained in two ways: How often the respondent plays a sport or exercises and how often the respondent walks for 20 minutes or more, with the five response categories of daily, several times a week, once a week, several times a month, at least once a month, not in the last month.

a. **Assessment of Physical Activity**

For these analyses, physical activity questions and responses were categorized into two variables for each wave: the first, pa_exer, classified responses into meets requirements of recommended daily physical activity (Nelson et. al., 2007; Elsayy, Higgins and Higgins, 2010; Norton, Norton and Sadgrove, 2010; American College of Sports Medicine, 2013) or does not meet requirements, and the second, pa_inten, was based on intensities of mild, moderate, or vigorous. If the respondent reported doing frequent, defined as daily (LB), several times a week (LB), more than once a week, once a week, or every day, mild-intensity physical activity (ascertained from the CORE and LB) their exercise intensity was coded as a mild. The same coding scheme is used for report of vigorous intensity activities and moderate intensity activities, with the highest reported intensity being selected if a respondent reported more than one activity conducted with frequent intensity. The two questions from the leave behind were coded as moderate activities and also used to construct the pa_exer variable. Consistent with recommendations from the American College of Sports Medicine (ACSM) and the American Heart Association (Nelson et al., 2007), the 2008 Physical Activity Guidelines

for Americans recommend that “for substantial health benefits, older adults should do at least 150 min a week of moderate-intensity, or 75 min a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity” (U.S. Department of Health and Human Services, 2008). To underscore the importance of physical activity for maintaining health at advanced ages, the government guidelines thus generally recommend the same level of physical activity for older adults aged 65 years and older that are used for younger adults below age 65 years. Since different combinations of moderate and vigorous intensity activities can achieve compliance with current physical activity guidelines, the above responses were combined into a single binary indicator denoting guideline compliance (ACSM, 2013; Kampfen and Maurer, 2016). Based on CDC and ACSM guidelines for physical activity for older adults, respondents were classified as meeting guidelines if they reported engaging in: (a) daily vigorous or moderate physical activity or both, (b) vigorous physical activity more than once a week and moderate physical activity at least 1–3 times per month, or (c) vigorous physical activity once a week and moderate physical activity more than once a week

A recent study by Kampfen and Maurer demonstrated the accuracy of this measurement approach by examining these estimations compared to less and more restrictive approaches to measuring compliance with guidelines (Kampfen and Maurer, 2016).

2. **Independent Variables**

The independent variables included whether or not the participant engaged in formal volunteer activity (measured as a dichotomous variable) and, conditional on

volunteering, whether the respondent volunteered with children or young people (generative role performance) and at which intensity the respondent volunteered (measured as <50 hrs, 50-100 hours, 101-200 hrs or >200hrs). All independent variables are based on items from the 2008 wave of the HRS CORE or the 2008 leave behind. All relevant items within the dataset that were selected for use as the independent variables are presented in Table XII, Appendix D: Independent Variables. Volunteer data were obtained from both the CORE and the leave behind questionnaire. To determine current volunteer status, respondents were asked, “Have you spent any time in the past 12 months doing volunteer work for religious, educational, health-related or other charitable organizations?” Then, to determine volume of volunteering, they were asked, “Altogether, would you say the time amounted to less than 100 hours, more than 100 hours, or what?” with response categories of less than 100 hours, about 100 hours, or more than 100 hours. They are then asked, “Would it be less than 200 hours, more than 200 hours, or what?” and “Would it be less than 50 hours, more than 50 hours, or what?” response categories similar to above but differing for respective hours and measured as a categorical variable. Generative volunteering status and “other volunteer work” were obtained from the leave behind and are based on a categorical measure of how often the respondent volunteers with children or young people: daily, several times a week, once a week, several times a month, at least once a month, or not in the last month. Volunteer intensity is presented as a categorical measure of total number of hours spent volunteering in the prior 12 months: Less than 50 hours per year, 50–100 hours per year, 101–200 hours per year, and over 200 hours per year.

a. **Characteristics of Volunteers**

The demographic and social characteristics of volunteers were assessed at the first wave and reported to compare characteristics of volunteers to non-volunteers and characteristics of generative volunteers to other volunteers; tables are presented in Chapter 4.

b. **Predictors of Generative Volunteering**

Demographic and socioemotional variables were assessed to examine the characteristics of generative versus non-generative volunteers prior to full longitudinal analysis. To measure variables related to SST, the following five scales from the CORE and leave behind psychosocial and lifestyle questionnaire were used; SST variables are detailed in Table XII, Appendix C: codebook of variables.

1. Life satisfaction index: This five-item measure of subjective well-being asks how much you agree or disagree with the following statements: “In most ways my life is close to ideal,” “The conditions of my life are excellent,” “I am satisfied with my life,” and “So far, I have gotten the important things I want in life.” Scored by computing the average score across the five items.
2. Social network: asks if respondents have a spouse, partner, children, family, or friends.
3. Social integration: asks respondents the extent to which they are in contact with social network.
4. Quality of relationships: asks about the closeness of the aforementioned relationships.
5. Social support: perceived quality of the aforementioned relationships.

These measures were selected based on prior research and are reliable and valid measures of subjective well-being. All of these measures have been included in the LB

since 2006 and indicate the types of relationships that older adults strengthen, maintain, or begin to narrow as they age as a component of SST (Hendricks and Cutler, 2004).

3. **Other Outcomes of Interest**

a. **Functional Limitations**

Questions on functional limitations, mobility, and assistance from helpers provide information on self-reported activities of daily living (ADLs) and instrumental activities of daily living (IADLs) and are reported in the CORE (Crimmins, Guyer, Langa, Ofstedal, Wallace, and Weir, 2008; Smith, Fisher, Ryan, Clarke, House, and Weir, 2013). Scoring and functional limitation questions are detailed in Table XII, Appendix C.

b. **Depression**

In each wave of the CORE survey, respondents are asked about eight common symptoms of depression, taken from the CES-D instrument. In validation studies against the full CES-D battery, the presence of four out of the eight symptoms is associated with clinically significant depression (Smith, Fisher, Ryan, Clarke, House, and Weir, 2013). CES-D composite scores from the RAND survey were used to assess respondent reported depression in the 2008, 2010 and 2012 waves.

4. **Covariates**

The following known covariates of physical activity were examined to determine whether they should be used as covariates in model selection in the models: age, self-rated health, health conditions, depression, comorbidities, and functional limitations. Variables were assessed one-at-a-time for significant association with the primary outcome variable (physical activity); those found to be significant at the 0.10

level were included as potential covariates in the complete model. Backwards-stepwise model selection was performed until all remaining covariates in each model were significant at the 0.05 level. Specifics for handling of covariates are detailed in Tables III and VI.

E. **Analysis**

The primary outcome for this analysis was physical activity. A series of bivariate, multivariate, and longitudinal models were run to examine the contribution of each variable in predicting volunteering and in predicting physical activity and how covariates impact these relationships. Analyses were conducted using SAS¹© version 9.4 software.

1. **Data Acquisition and Preparation**

All data were downloaded from the HRS website and merged as described previously. RAND data files were used for the majority of the data analyses with the exception of the most recent time varying data from 2014 waves where early release raw data instead was pulled from the HRS site because final HRS versions and RAND data were not yet available.

¹The code/data analysis for this dissertation was generated using SAS software, Version 9.4 of the SAS System for Windows. Copyright © 2015 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

TABLE III: MEASURES

Independent Variable	MEASURE
Currently Volunteering	0=No 1=Yes
Volunteer Intensity (hours per year)	<50hrs, 50-100, 101-200, >200
Volunteer with Children	0=No 1=Yes
Dependent Variable	MEASURE
Physical Activity (Mild, Moderate, Vigorous)	0= Sedentary 1=Mild, 2=Moderate, 3=Vigorous
Meets Requirements	0=No 1=Yes
Covariates	MEASURE
Age	Continuous variable, age at 2008 interview Categorical Age brackets in 5 year increments from under 50-55, 56-60, 61-65, 66-70, 71-75, 76-80, 81-85, >=86
Race/Ethnicity	0=Non-Hispanic white, 1=Non-Hispanic black, 2=Non-Hispanic other
Gender	0=Male, 1=Female
Marital Status	0=married, 1=married spouse absent, 2=partnered, 3=separated, 4=divorced, 5= sep/div 6=widowed, 7=never married
Education	0=Less than HS, 1=GED, 2=HS, 3=Some college, 4=College and above
Retirement Status	0=Employed not retired, 1=Retired 2=retired and employed
Income	Categorical, brackets from <25,000; 25-50,000; 50-75,000; 75,000-100,000; >100,000
Region of Country	0=Northeast, 1=Midwest, 2=South, 3=West 5=other
Self-Reported Health	1=Fair, 2=Poor, 3=Good, 4=Very Good, 5=Excellent, =Missing
Secondary Outcomes	MEASURE
Health Conditions/Comorbidity Index	0=No conditions, 1=One condition from below list, 2=Two or more conditions from below list. =Missing 1) High blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor of any kind except skin cancer; 4) chronic lung disease, except asthma, such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism
Functional Limitations (mobility index)	0=No mobility limitations, 1=One or more mobility limitations, =Missing 0-5 The five tasks included in the index are walking several blocks, walking one block, walking across the room, climbing several flights of stairs, and climbing one flight of stairs.
Functional Limitations (lrg muscle index)	0=No functional limitations, 1=One or more functional limitations, =Missing 0-4 The four tasks included in the index are sitting for two hours; getting up from a chair; stooping, kneeling, or crouching; and pushing or pulling a large object.
Depression	0=No depressive symptoms, 1=Depressive symptoms, =Missing (those with score of 3 or more on CES-D8 classified as having clinically depressive symptoms [not 0-8 as original])

Frequencies were examined for all variables in order to check for consistency within data sets, missingness, and outliers. Variables were created and renamed as previously detailed. Independent summary scores including individual scores for SST variables were calculated as detailed above. For households where multiple members are included in the study one member of each household was randomly selected using SAS after limiting the sample to complete case data from all waves.

2. **Missing Data and Multiple Imputation**

The RAND HRS data include model-based imputations of missing data for some variables. In the cases where missing values still remain missing completely at random, MCAR tests were employed. The HRS staff had already determined that some data were not missing completely at random (MCAR) within the Core Fat Files, but were instead missing at random (MAR) (Smith, Fisher, Ryan, Clarke, House, and Weir, 2013). The present analyses used complete case data for volunteering and physical activity, so imputation of missing data for the primary outcome and predictor variables was not performed.

3. **Grouping**

Comorbidity scores were grouped according to number of comorbidities where 0= no comorbidities, 1= one condition from proceeding list, 2= two conditions, and so on. Scores ranged from zero to eight. Comorbidities that were included are (1) high blood pressure or hypertension; (2) diabetes or high blood sugar; (3) cancer or a malignant tumor of any kind except skin cancer; (4) chronic lung disease, except asthma, such as chronic bronchitis or emphysema; (5) heart attack, coronary heart disease, angina,

congestive heart failure, or other heart problems; (6) stroke or transient ischemic; (7) emotional, nervous, or psychiatric problems; and (8) arthritis or rheumatism.

4. **Univariate and Bivariate Analyses**

The goal of these analyses was to evaluate whether volunteering, including type and intensity, has a significant effect on the likelihood of being physically active over a period of six years (from 2008 to 2014). The analyses include frequency for categorical variables or central tendency (mean) and dispersion (standard deviation) for continuous variables. Descriptive analyses were performed to examine common versus distinct characteristics of volunteers, non-volunteers, and generative versus other volunteers and to describe the characteristics of the study sample at wave 1. Chi-square, Fishers exact, one-way ANOVA, and t-tests were performed to compare the frequencies and means of the potential covariates.

5. **Modeling Strategy**

This study used mixed effect models to examine the association of volunteering and physical activity. Using mixed models allows investigators to take advantage of time-varying covariates and outcomes (McArdle, Fisher, and Kadlec, 2007). To assess time varying predictors and outcomes, data were transformed and renamed when necessary to fit SAS models. Volunteer data for multiple time points were labeled such that they were understood as a series by the software. According to Hedeker and Gibbons (2006), some of the many advantages of mixed models are, “that they allow researchers to explicitly model individual change across time; they are more flexible in examining repeated measures (do not require the same number of observations for each subject, and time can be continuous rather than fixed sets of points); they are flexible in

the specification of the covariance structure among repeated measures and provide methods for testing the determinants of this structure; and they can be extended to higher level models including repeated observations within individuals and within cohorts. Mixed models also allow for generalizations for non-normal data” (Hedeker and Gibbons, 2006). Overall, this method enables researchers to take full advantage of the longitudinal data in the HRS by looking at all times, trajectories, and change and providing a more nuanced look at change over time in a more flexible way.

The analytical sample included respondents who were at least 50 years of age and had non-missing data for physical activity, volunteering, and race. Data were analyzed via random-intercept logistic regression modeling. All statistical analyses were conducted in SAS© 9.4.

Formal volunteering was defined using the variables (1) volunteer work with church or other organization and (2) volunteer work with children or young people. This study examined the health outcomes of volunteers versus non-volunteers with respect to physical activity and also compared health outcomes of generative volunteers to those who did not report engaging in generative volunteering. Volunteer intensity was measured categorically by total hours reported (less than 50, 50-100, 101-200, and greater than 200).

Specific hypotheses tested included the following:

Hypothesis 1: Formal volunteering is positively associated with engagement in physical activity among older adults.

Analysis 1: Logistic longitudinal mixed models were used to examine the association between volunteerism and physical activity, controlling for

baseline levels of volunteerism and physical activity and other covariates found to be significantly associated with this outcome.

Hypothesis 2: Formal volunteering is positively associated with sustained physical activity across four waves of longitudinal data.

Analysis 2: Volunteer status was analyzed in a longitudinal model to test whether formal volunteering at time one was predictive of sustained PA through the three subsequent waves of data.

Hypothesis 3: Beneficial outcomes of volunteering, including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms among older adults vary as a function of the intensity (hours per year) of volunteering.

Analysis 3: Spearman correlation tests at each time point were used to determine if health outcomes varied by differing intensity in hours (50, 100, 200 hours) of volunteering. Health benefits included self-reported health, functional status, reduction or absence in depressive symptoms, and physical activity. Variables were examined cross-sectionally

Hypothesis 4: Beneficial outcomes of volunteering, including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms among older adults are *greater* when volunteering includes a generative component, which entails working with a younger generation.

Analysis 4: Spearman correlations were used to assess if those who participate in formal volunteering with children or young people (generative

volunteering) reported greater beneficial health outcomes, including physical activity, self-reported health, functional status, and reduction or absence of depressive symptoms.

Hypothesis 5: Formal volunteering that is associated with generative role performance (volunteering with youth) will be positively associated with physical activity over four time periods.

Analysis 5: Generative volunteer variables were analyzed using multivariable logistic regression to test whether volunteering with children in 2008 predicted sustained PA through the three subsequent waves of data (2010, 2012, 2014) controlling for baseline physical activity.

F. **Human Subjects Protection**

1. **University of Illinois at Chicago Institutional Review Board**

Since this study was a secondary analysis of HRS data, an exemption was obtained from the University of Illinois at Chicago Institutional Review Board (IRB). The IRB was provided with information about the study, specifying that the data are publicly available and that analyses are limited to existing data. The study was therefore eligible for an exemption under category 4 (45 CFR 46.102[f]).

2. **Health and Retirement Study**

The staff of the HRS participates in a substantial amount of training to ensure protection to subjects and takes several precautions to ensure continued confidentiality. First, the names, addresses, and contact information of all HRS participants are maintained in a secure control file. Second, a pledge of confidentiality is signed by all personnel and affiliates who have access to identifying information. This

pledge disallows disclosure of any information about study subjects. Third, prior to releasing survey data to researchers, all identifying information is removed. Fourth, data are made available only to qualified researchers via a secure website, and access permission is granted only after application and registration. Fifth, the linked data from Social Security and Medicare records or other sources are strictly controlled as restricted data. Access to restricted data is an entirely different application with a lengthy approval process only for researchers in secure facilities that are inspected or audited at random to ensure compliance. Last, the HRS study team has prevented any forced disclosure of HRS data by obtaining a certificate of confidentiality from the National Institutes of Health.

IV. RESULTS

This chapter presents findings from analyses in the following order: sample description, missing data, descriptive statistics, bivariate analyses, regression analyses and longitudinal analyses. The chapter concludes with a review of the study aims and hypotheses and specifies which hypotheses were supported by the results. The appendices include all formatted results, tables, and figures referenced in this chapter.

A. Sample Description

For increased sensitivity and continuity across variables, the current analysis included the four data waves spanning years 2008 to 2014. This analysis used Early Release data from the HRS (year 2014). These data have not been finalized, and some variables are not consistent with RAND data sets from version O. Cleaned and updated versions of data thus may contain errors that will be corrected in the final Public Release version of the data set. However, the impact to the results of the current analysis should be none to minimal because no relevant edit alerts to the early release data have been issued.

1. Study Sample

Participants were selected into this analysis using the following inclusion criteria: Individuals who had non-missing data on both volunteering and physical activity from 2008 to 2014 were included. Consistent with HRS's target participants, participants aged 50 and older were included. In 2008, 360 individuals who were under age 50 were excluded from the original sample of 17,217, representing 2.06 percent of the total original sample and resulting in a new sample of 16,857 individuals. Respondents were

then excluded if they were missing all volunteer data which included any from the 2008 CORE survey or the two variables from the leave behind survey of that same year, volunteer with children and volunteer for church or other organization ,resulting in the same sample size of 16,857 individuals. Next, individuals missing information on physical activity were excluded resulting in a sample size of 16,851. Participants were excluded if they were missing information on race, resulting in a final sample size of 16,850. The same criterion was applied at each wave resulting in final sample sizes at waves two, three and four of 22,011; 20,534; and 18,726, respectively. Finally, to avoid confounding due to multiple participants per household, one member from each household was randomly selected to serve as the representative for that household after the four waves of data were combined, resulting in a final sample size of 8,228 across four waves of data.

2. Descriptive Statistics

Baseline demographic characteristics of the total sample and primary independent variables are presented in Table IV and compared by volunteer status. The sample consists of 8,228 adults over the age of 50. The unweighted sample is primarily female (64 percent), Caucasian (81.0 percent), and married or living with a partner (56 percent). Compared to non-volunteers, volunteers were significantly more likely to be female, Caucasian, non-Hispanic, married, more highly educated, retired, and from the Midwest. Income and volunteering had a linear relationship, volunteers were consistently more likely than non-volunteers to be of higher income at every point above 25,000 dollars annual income. While the mean ages of the volunteers and non-volunteers were roughly equivalent, the sample is not normally distributed, and the breakdown by age

category reveals that volunteers are significantly more likely to be in older age categories than non-volunteers. Mean ages of the sample were calculated using t tests. Chi square tests were performed for all categorical variables presented in the table below.

In 2008 1,563 of the 3,285 volunteers had data on whether or not they volunteered with children with 50 percent of the data missing due to ineligibility. Of the 1,563 individuals who responded to the LB question on volunteering with children, 544 reported volunteering with children. The questions on volunteering with children come from the leave behind questionnaire, asked of only half of the total sample at the first wave then asked of the other half of the eligible sample at the subsequent wave. The minimum amount of missing LB data at each wave is 50 percent due to eligibility. Compared to non-generative volunteers (standard formal volunteers), volunteers who reported volunteering with youth (generative volunteers) were statistically significantly more likely to be younger with regard to both mean and categorical age. In contrast to the profiles of standard formal volunteers in the study, generative volunteers were also more likely to be female, black, Hispanic, have a lower education level, be employed, and be of lower income and from the South.

B. Impact of Covariates on Physical Activity

1. Demographics and Covariates

At baseline, 47 percent of the total sample of volunteers and non-volunteers (N=8,228) reported meeting minimum requirements of physical activity for older adults; specifically, 43 percent of women met guidelines, and 54 percent of men reported meeting guidelines. Among non-Hispanic whites, 84 percent met guidelines compared to 13 percent of non-Hispanic blacks. Ninety-two percent of those meeting guidelines were

TABLE IV: DESCRIPTIVE STATISTICS OF SAMPLE VOLUNTEERS (ANY TYPE)
VERSUS NON-VOLUNTEERS IN 2008

Variable	Volunteer (NO)	Volunteer (YES)	Total
Age (years) p = .0004	N (%)	N (%)	N
50-59	1270 (25.69)	815 (24.81)	2085
60-65	696 (14.08)	469 (14.28)	1165
66-70	1011 (20.45)	678 (20.64)	1689
71-75	824 (16.67)	639 (19.45)	1463
76-80	563 (11.39)	384 (11.69)	947
81-85	356 (7.20)	203 (6.18)	559
>=86	223 (4.51)	97 (2.95)	320
Total	4943	3285	8228
Sex, n (%) p= .0002			
Female	3092 (62.55)	2185 (66.51)	5277
Race/ethnicity, n (%) p= .0004			
Non-Hispanic white	3992 (80.76)	2667 (81.19)	6659
Non-Hispanic black	761 (15.40)	542 (16.50)	1303
Non-Hispanic other	190 (3.84)	76 (2.31)	266
Total	4977	3261	8228
<i>Not Hispanic</i>	<i>4352 (88.06)</i>	<i>3099 (94.34)</i>	<i>7451</i>
<i>Hispanic</i>	<i>590 (11.94)</i>	<i>186 (5.66)</i>	<i>776</i>
<i>Total</i> p< .0001	<i>4942</i>	<i>3285</i>	8227
Education, n (%) p= < .0001			
Less than high school GED	1258 (25.46)	357 (10.87)	1615
GED	254 (5.14)	124 (3.78)	378

TABLE IV: DESCRIPTIVE STATISTICS OF SAMPLE VOLUNTEERS (ANY TYPE)
VS. NON-VOLUNTEERS IN 2008 (continued)

Variable	Volunteer (NO)	Volunteer (YES)	Total
High school graduate	1626 (32.90)	929 (28.29)	2555
Some college	1040 (21.04)	830 (25.27)	1870
College and above	764 (15.46)	1044 (31.79)	1808
Total	4942	3284	8226
Marital status, n (%) p= < .0001			
Married	2463 (49.84)	1877 (57.14)	4340
Married, spouse absent	31 (.63)	20 (.61)	51
Partnered	179 (3.62)	69 (2.10)	248
Separated	105 (2.12)	48 (1.46)	153
Divorced	712 (14.41)	376 (11.45)	1088
Separated/Divorced	2 (.04)	1 (.03)	3
Widowed	1246 (25.21)	770 (23.44)	2016
Never married	204 (4.13)	124 (3.77)	328
Total	4942	3285	8227
Employment status, n (%) p= .0002			
Not retired	2516 (50.98)	1527 (46.50)	4043
Retired only	2079 (42.13)	1489 (45.34)	3568
Retired and otherwise employed	340 (6.89)	268 (8.16)	608
Total	4935	3284	8219
Region of Country p= < .0001			
Northeast	785 (15.88)	448 (13.64)	1233
Midwest	1168 (23.63)	940 (28.62)	2108
South	2031 (41.10)	1295 (39.43)	3326
West	947 (19.16)	598 (18.21)	1545
Other	11 (.22)	2 (.09)	14

TABLE IV: DESCRIPTIVE STATISTICS OF SAMPLE VOLUNTEERS (ANY TYPE)
VS. NON-VOLUNTEERS IN 2008 (continued)

Variable	Volunteer (NO)	Volunteer (YES)	Total
Total	4942	3284	8226
Income p< .0001			
< 25,000	1971 (39.87)	863 (26.27)	2834
25,000-50,000	1288 (26.06)	935 (28.46)	2223
50,000-75,000	717 (14.51)	533 (16.23)	1250
75,000-100,000	343 (6.94)	319 (9.71)	662
>100,00	624 (12.62)	635 (19.33)	1259
Total	4943	3285	8228

TABLE V: DESCRIPTIVE STATISTICS OF GENERATIVE VERSUS NON-GENERATIVE VOLUNTEERS IN 2008

Variable	Volunteer with Children (NO)	Volunteer with Children (YES)	Total (N=1636)
Age (years) p <.0001	N (%)	N (%)	N
50-59 total sample	223 (21.88)	152 (27.94)	375
60-65	132 (12.95)	94 (17.28)	226
66-70	205 (20.12)	127 (23.35)	332
71-75	217 (21.30)	93 (17.10)	310
76-80	131 (12.86)	47 (8.64)	178
81-85	77 (7.56)	23 (4.23)	100
>=86	34 (3.34)	8 (1.47)	42
Total	1019	544	1563
Sex, n (%) p = .0135			
Female	670 (65.75)	391 (71.88)	1061
Race/ethnicity, n (%) p < .0001			
Non-Hispanic white	889 (87.24)	383 (70.40)	1272
Non-Hispanic black	112 (10.99)	141 (25.92)	253
Non-Hispanic other	18 (1.77)	20 (3.68)	38
Total	1019	544	1563
<i>Not Hispanic</i>	<i>978 (95.98)</i>	<i>486 (89.34)</i>	<i>1464</i>
<i>Hispanic</i>	<i>41 (4.02)</i>	<i>58 (10.66)</i>	<i>99</i>
Education, n (%) p < .0001			
Less than high school	104 (10.21)	97 (17.83)	201
GED	37 (3.63)	15 (2.76)	52
High school graduate	297 (29.15)	160 (29.41)	457
Some college	256 (25.12)	132 (24.26)	388
College and above	325 (31.89)	140 (25.74)	465
Marital status, n (%) p = .0003			
Married	581 (57.02)	294 (54.04)	875
Married, spouse absent	7 (0.69)	4 (0.74)	11
Partnered	24 (2.36)	15 (2.76)	39
Separated	12 (1.18)	9 (1.65)	21
Divorced	115 (11.29)	68 (12.50)	183

TABLE V: DESCRIPTIVE STATISTICS OF GENERATIVE VERSUS NON-GENERATIVE VOLUNTEERS IN 2008 (continued)

Variable	Volunteer with Children (NO)	Volunteer with Children (YES)	Total (N=1636)
Separated/Divorced	0	0	0
Widowed	229 (22.47)	134 (24.63)	363
Never married	51 (5.00)	20 (3.68)	71
Employment status, n (%) p< .0001			
Employed	431 (42.30)	283 (52.02)	714
Retired	506 (49.65)	207 (38.05)	713
Retired and employed	82 (8.05)	54 (9.93)	136
Census Region p= .0225			
Northeast	136 (13.36)	68 (12.50)	204
Midwest	301 (29.57)	134 (24.63)	435
South	383 (37.62)	247 (45.40)	630
West	198 (19.45)	94 (17.28)	292
Other	0	1	1
Income p= .0005			
< 25,000	264 (25.91)	186 (34.19)	450
25,000-50,000	273 (26.79)	156 (28.68)	429
50,000-75,000	168 (16.49)	83 (15.26)	251
75,000-100,000	106 (10.40)	44 (8.09)	150
>100,00	208 (20.41)	75 (13.79)	283
Total	1019	544	1563

^a Chi square tests were performed for all categorical variables listed above.

^b T-tests were performed for continuous age only.

non-Hispanic compared to 8 percent among Hispanics. Those with a college degree and higher were significantly more likely to meet guidelines, and overall higher education and income were associated with greater likelihood of meeting guidelines. Married persons were significantly more likely to report meeting guidelines than their unmarried counterparts, as were those who are retired. Respondents from the Northeast and the West were more likely to report meeting physical activity guidelines, and respondents from the South were significantly less likely to report meeting guidelines. With respect to intensity of exercise, 40 percent of the sample reported participating in vigorous exercise, and 43 percent reported participating in moderate physical activity in 2008. When the relationship between the covariates and physical activity intensity at baseline was examined, younger age was associated with increased likelihood to report more intense physical activity up to about age 71. At that age, physical activity intensity was similar across intensities until age 76 and above, at which point, with increased age, intensity of physical activity began to lessen. Females were more likely to report being sedentary and performing mild physical activity while males reported greater likelihood of moderate and intense physical activity. Non-Hispanic whites were more likely to report participating in higher intensity physical activity while non-Hispanic blacks reported less intense physical activity at each level of intensity (mild, moderate and vigorous). Education and physical activity had a linear, positive relationship and married persons were consistently more likely to report higher intensity physical activity than non-married persons. People with higher incomes and who lived in the West also reported higher levels of physical activity intensity. Demographic tables for respondents that met or did not meet guidelines as well as their physical activity intensity can be viewed in

appendices F and G, respectively. All known covariates of physical activity were examined and used as covariates in model selection in the proceeding models. As displayed in Table IV and V, variables were assessed one at a time for significant association with the primary outcome variable (PA); those found to be significant at the 0.10 level were included as potential covariates in the complete model. Backwards-stepwise model selection was performed until all remaining covariates in each model were significant at the 0.05 level and are presented in table VI. Table VI portrays bivariate associations between PA outcomes, predictor variables, and covariates, including descriptive information of the magnitude of each association. At the bivariate level, meeting PA guidelines was significantly and positively correlated ($p < 0.0001$) with volunteering, time, gender, race, education, income, census region, and self-rated health. No significant difference was observed over time for volunteering indicating that both non-volunteers and volunteers were less likely to meet guidelines over time; however volunteers maintained higher levels of physical activity and greater likelihood to continue meeting guidelines over time. Similarly, for volunteers, the higher the self-report of health at baseline the more likely they were to meet guidelines over time.

C. **Multivariate Effects of Volunteering on Physical Activity**

1. **Volunteering**

A longitudinal one to one test of association found that retirement status was the only variable that was not significantly correlated with meeting physical activity guidelines. After controlling for race, age, gender, region, education, income, reported self-health, and the increasing effects of age and reported self-health over time, volunteers were still significantly more likely than non-volunteers to meet physical

TABLE VI: LOGISTIC REGRESSION MODEL OF VOLUNTEERING AND COVARIATES WITH LIKELIHOOD TO REPORT MEETING PA GUIDELINES

Variable	B	SE	<i>p</i>
Volunteer (Y/N)	0.4892	0.04683	<.0001
Time (mean difference between PA behavior at each time point)	0.3892	0.09217	<.0001
Age (continuous)	-0.00458	0.002622	0.0809
Gender (ref: male)			
Female	-0.4331	0.03732	<.0001
Race/Ethnicity (ref: non-Hispanic white)			
Non-Hispanic black	-0.1626	0.05004	0.0012
Non-Hispanic other	0.1036	0.09934	0.2972
Income Category (ref: lowest income)	0.07801	0.01530	<.0001
Education Category (ref: lowest education)	0.1178	0.02572	<.0001
Marital status (ref: never married)			
Previously married	-0.04453	0.09087	0.8822
Married	0.01355	0.09139	0.6241
Census Region (ref: West)			
Northeast	-0.1719	0.05979	0.0040
Midwest	-0.3004	0.05248	<.0001
South	-0.2795	0.04900	<.0001
Self-Rated Health	-0.3721	0.02315	<.0001
<i>Time * Vol</i>	0.02728	0.02394	0.2544

TABLE VI: LOGISTIC REGRESSION MODEL OF VOLUNTEERING AND COVARIATES WITH LIKELIHOOD TO REPORT MEETING PA GUIDELINES (continued)

Variable	B	SE	<i>p</i>
<i>Time * Age</i>	-0.00505	0.001198	<.0001
Time * Self-health	-0.03371	0.01156	0.0036

^a Volunteer status was the primary predictor variable for meeting PA guidelines. All other variables are covariates controlled for due to significance.

^b All items were categorical variables except continuous age.

^c Referent (ref) categories were low unless otherwise noted.

activity guidelines. The interaction of time with age and volunteer status revealed that while reports of meeting guidelines decreased across the board for all respondents over time, persons who volunteered were more likely to meet physical activity guidelines over time than non-volunteers. Men were significantly more likely to report meeting guidelines, as were individuals with higher education levels, higher income, and individuals living in the West. African Americans were significantly less likely to report meeting guidelines; increased age and poorer self-reported health were also significantly associated with decreased likelihood of reporting meeting guidelines. When secondary outcomes were assessed over three waves of data, volunteers were significantly less likely to report being depressed and were significantly less likely to exhibit functional limitations including mobility (e.g., timed walked tests, balance), ADLs, large muscle, gross motor, and fine motor indices at all three time points. Volunteers were also consistently and significantly ($p < .0001$ at all time points) less likely than non-volunteers to report health conditions, negative changes in self-reported health, ADL limitations, mobility limitations, large muscle functional limitations, lower self-reported health scores, and depression (see appendices J and K for secondary outcome analyses).

2. **Volunteer Intensity**

To determine whether the relationship of volunteering and physical activity varied based on intensity of volunteering at multiple time points, further analyses were conducted using hours of volunteering. Findings are presented in Table VII.

Of the people who did not volunteer in 2008, 40.52 percent met PA guidelines; of the people who volunteered less than 50 hours, 52.03 percent met guidelines; of the 50-

100 hours per year volunteers, 54.44 percent met guidelines; of the 100-200 hours per year volunteers, 58.85 percent met guidelines; and of the greater than 200 hours per year volunteers, 59.59 percent met guidelines.

This pattern of increasing likelihood of meeting physical activity guidelines with increased participation in formal volunteering continued throughout the following three waves at the $p < 0.0001$ level of significance, demonstrating a strong association between volunteer intensity and self-report of meeting PA guidelines at every time point.

Additional analyses on volunteering and physical activity at baseline are shown in Tables XVII and XVIII, Appendices H and I respectively. Table XVII, Appendix H demonstrates similar findings for 2008, that volunteering and meeting physical activity guidelines are highly correlated and that those who report volunteering are more likely to meet physical activity requirements. Table XVIII, Appendix I illustrates that volunteers are more likely to perform higher intensity levels of physical activity than non-volunteers. Secondary outcome analyses of volunteer intensity revealed that with each increase in intensity of volunteering, volunteers were also increasingly less likely to report being depressed, having functional limitations, reduction in self-reported health, and increases in health conditions at all three time points (see Table XIX, Appendix J).

3. **Volunteering with Children**

When volunteering with children was examined, it was not significantly correlated with whether generative volunteers met physical activity guidelines in 2008 (Table VIII) or reported greater levels of physical activity intensity (Table IX).

Volunteering with children was also not associated with greater likelihood to meet guidelines over multiple time points (Table X).

TABLE VII: CORRELATIONS OF VOLUNTEER INTENSITY AND PHYSICAL ACTIVITY (MEETS GUIDELINES)

Variable	2008	2010	2012	2014
	N (%)	N (%)	N (%)	N (%)
Not Volunteering	2003 (40.52)	1855 (37.36)	1850 (35.58)	1759 (32.87)
<50 hr.	500 (52.03)	501 (47.90)	467 (48.09)	450 (49.89)
50-99 hr.	374 (54.44)	364 (52.30)	340 (50.60)	290 (49.40)
100-199	256 (58.85)	252 (53.16)	247 (53.93)	250 (54.70)
>= 200	351 (59.59)	319 (53.89)	282 (56.06)	313 (58.50)

*P <0.0001 at all time points.

TABLE VIII: SPEARMAN CORRELATION FOR VOLUNTEERING WITH CHILDREN AND MEETS OR DOES NOT MEET PHYSICAL ACTIVITY GUIDELINES, 2008

PA Requirements	Other Volunteer (not with children)	Volunteer with children	Total
(p= 0.7111)	N (%)	N (%)	N (%)
Does not Meet Requirements	324 (31.80)	168 (30.88)	492
Meets Requirements	695 (68.20)	376 (69.12)	1071
Total	1019	544	1563

TABLE IX: SPEARMAN CORRELATION FOR VOLUNTEERING WITH CHILDREN AND INTENSITY OF PHYSICAL ACTIVITY

PA Intensity	Other Volunteer (not with children)	Volunteer with children	Total
(p= <0.7208)	N (%)	N (%)	N (%)
Vigorous	505 (49.56)	259 (47.61)	764
Moderate	441 (43.28)	238 (43.75)	679
Mild	63 (6.18)	40 (7.35)	103
Sedentary	10 (0.98)	7 (1.29)	17
Total	1019	544	1563

TABLE X: SPEARMAN CORRELATIONS OF VOLUNTEERING WITH CHILDREN AND PHYSICAL ACTIVITY AT FOUR TIME POINTS

Correlation (95% CI) p-value	2008	2010	2012	2014
PA Guidelines	0.009 (-.040, 0.059) p= 0.7113	0.036 (-0.031, 0.102) p= 0.2902	0.067 (-0.005, 0.139) p= 0.0695	0.056 (-0.014, 0.126) p= 0.1167
PA Intensity	-0.024 (-0.073, 0.026) p= 0.3511	0.006 (-0.061, 0.072) p= 0.8693	-0.011 (-0.083, 0.062) p= 0.7724	0.026 (-0.045, 0.096) p= 0.4738
Age	-0.144 (-0.193, -0.095) p <0.0001	-0.064 (-0.108, -0.019) p=0.0055	-0.091 (-0.136, -0.046) p <0.0001	-0.062 (-0.109, -0.015) p= 0.0103

Analyses did not reveal a strong relationship between volunteering with children and meeting physical activity guidelines or having a higher PA intensity over time than was demonstrated with other types of volunteering. Multivariate analyses examining volunteering with children and psychosocial variables; however, found a significant relationship between psychosocial variables used to test theoretical predictors of volunteering with children such as social support and quality of social relationships. The results are displayed below in Table XI.

Results presented in Table XI demonstrate that people who volunteer with children feel more significant purpose in life compared to volunteers who do not volunteer with children. When examining the impact of positive and negative social support, respondents who report having a good relationship with their spouse were neither more nor less likely to report volunteering with children; however, if they reported a poor relationship with their spouse (higher negative spousal social support) they were significantly more likely to volunteer with children. Volunteers who reported a good relationship with their children were significantly more likely to report volunteering with children (than other formal volunteering), and perhaps more striking, those who reported high negative social support from their own children were even more likely to report volunteering with youth, suggesting that generative volunteering may serve to compensate older adults for negative relationships with their own children. The same finding was observed for positive and negative relationships with “other” family members. When examining the impact of friend social support, there was no significant impact of good relationships with friends on volunteering with children, but volunteers

who reported higher negative social support scores in the friends category were much more likely to volunteer with children.

Consistent with SST, purpose in life, age, and subjective age were also all significantly correlated with volunteering with children.

D. **Review of Study Aims and Hypotheses**

This study was designed to address gaps in our knowledge by answering the following question: What is the association between volunteering and physical activity in older adults? The aim of this study was to determine key dimensions of volunteering that are associated with and predict physical activity in older adults within each of four waves of data and over time by testing the following hypotheses.

1. **Hypotheses 1 and 2:**

Formal volunteering is positively associated with engagement in physical activity among older adults.

The results of the longitudinal modeling of the relationship between volunteering and physical activity controlling for all known covariates supported the hypothesis that formal volunteering is positively associated with engagement in physical activity among older adults, as well as hypothesis two that formal volunteering is positively associated with sustained physical activity across four waves of longitudinal data.

2. **Hypothesis 3:**

Beneficial outcomes of volunteering, including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms among older adults vary as a function of the intensity (hours per year) of volunteering.

This hypothesis was supported by the findings of this study. Secondary outcome data are presented in appendices J and K. Volunteers exhibited significantly lower likelihood of depression, better self-reported health and better functional status than non-volunteers across three waves of cross-sectional data. Similar significant relationships were seen between intensity of volunteering and secondary outcomes.

3. **Hypothesis 4:**

Beneficial outcomes of volunteering, including physical activity, functional status, self-rated health, and reduction or absence of depressive symptoms among older adults are *greater* when volunteering includes a generative component, which entails working with a younger generation.

The fourth hypothesis was not supported by the findings of this study. Volunteering with children in 2008 did not result in higher likelihood of meeting PA guidelines than non-generative volunteering. Additionally, volunteering with children did not result in a higher likelihood of other beneficial outcomes including self-rated health, functional status, and absence of depression than non-generative volunteering.

4. **Hypothesis 5:**

Formal volunteering that is associated with generative role performance (volunteering with youth) will be positively associated with physical activity over four time periods.

It was not possible to examine volunteering with children over several time points and thus difficult to assess the longitudinal relationship between volunteering with children and physical activity.

TABLE XI: CORRELATION OF PSYCHOSOCIAL VARIABLES WITH
GENERATIVE VOLUNTEERING AT BASELINE

SST Variables	Volunteer with Children				
	Correlation (95% CI) P value				
	0.016 (-0.034 – 0.066) p= 0.533				
Life Satisfaction					
Purpose In Life	0.067 (0.017 – 0.117) p= 0.008				
Social Integration (Social Networks composition)	0.004 (-0.045, 0.054) p= 0.8639)				
Quality of Relationships					
Social Support (Positive)	Spouse -0.024 (- 0.088, 0.040) p= 0.4561	Children 0.068 (0.015, 0.120) p= 0. 0112	Family (other) 0.116 (0.065,0.1 66) p < .0001	Friends 0.020 (-0.030, 0.071) p =0.4344	
Social Support (Negative)	0.064 (0.0002, 0.127) p= 0.0491	0.157 (0.105, 0.208) p<0.0001	0.105 (0.053, 0.155) p < .0001	0.086 (0.035,0.13 6) p= 0.0009	
Age	-0.144 (-0.193, -0.095) p <0.0001				
Objective Age (what age do you feel)	-0.116 (-0.165, -0.065) p < .0001				

E. **Conclusions**

Volunteers were more likely to report meeting national physical activity guidelines over an eight-year period across four waves of longitudinal data than non-volunteers. The entire sample became less likely to meet physical activity guidelines over time, but volunteers remained at a higher likelihood than non-volunteers to meet guidelines despite the overall trend in the sample of declining likelihood. Volunteer intensity was correlated with physical activity intensity and meeting guidelines over four time points and those who volunteered with children experienced added psychosocial benefits. The implications of these findings are discussed in Chapter 5.

V. CONCLUSIONS

A. Discussion

The purpose of this study was to examine the association between volunteering and physical activity in a nationally representative sample of adults age 50 and older. Specifically, this study examined the association between volunteering and measures of physical activity including meeting current recommended guidelines. Volunteering included whether or not the participant reported volunteering in the past year, how many hours the participant reported volunteering in the past year, and for a smaller subsample, how many of the current volunteers reported volunteering with youth. While there is evidence suggest that volunteering is associated with physical activity and theoretical implications suggesting volunteering with children is associated with psychosocial benefits, this is the first study to analyze directly the association between volunteering, including type and intensity, and physical activity at multiple time points including after the measured behavior is no longer reported. This chapter presents an interpretation of the study findings with implications and suggestions for future research in this area. The chapter concludes with a discussion of the study's limitations and a call for the use of volunteering as a mechanism to promote and sustain physical activity in adults as they age.

To address the aim of this study a secondary data analysis was conducted using data from the Health and Retirement Study, a nationally representative sample of adults age 50 and older in the United States, using four data waves spanning from 2008 to 2014. Demographic characteristics and health factors assessed in 2008 were used as baseline data. Volunteer data were assessed in 2008 from the CORE survey and from the leave

behind survey, where available, and used in analyses as independent variables. Physical activity was assessed as meeting physical activity guidelines and as intensity of reported physical activity including mild, moderate, and vigorous activity as well as walking for 20 minutes or more and reported frequency of sport or exercise. The sample was limited to those 50 and older and who had data on volunteering and physical activity at all four waves of interest. A series of bivariate and multivariate models were run to examine the effects of volunteering independently, then a series of covariates were added into the models. Each model was run for all significant covariates at 2008 and 2014, and several models were run for each wave independently as well as across waves in longitudinal models.

Consistent with other studies of older adult volunteering, volunteers were more likely than non-volunteers to be Caucasian, female, married, and of higher income and education. Also consistent with other literature, participation in formal volunteering was positively associated with physical activity (Tan, 2006), higher self-reported health (Jenkinson et al., 2013), fewer depressive symptoms (Morrow-Howell, Hinterlong, Rozario, and Tang, 2003) and fewer functional limitations (Barron et al., 2009) among older adults, cross-sectionally. In particular, increased intensity of volunteer hours per year was found to promote a higher likelihood of meeting physical activity guidelines. While analyses found that all groups decreased in likelihood to meet physical activity guidelines over time, volunteers maintained a consistently higher likelihood to meet guidelines than non-volunteers.

The sample for this study was drawn from a nationally representative, random sample of participants; however certain limitations could have biased the sample. To

assess the likelihood of any major differences, unweighted demographics of the study sample were compared to those of the general U.S. population in 2008 as reported by the U.S. Department of Health and Human Services (USDHHS, 2008). It should be noted that some of the referent samples of the general U.S. population included an age cutoff that was older (65 years and older) than the study sample (age 50 years and older). Additionally it should be noted that the current study used unweighted sample estimates while the referent used weighted samples for the U.S. population.

This comparison showed that the study sample is reflective of the general American population in several areas including gender (66 percent female in this sample, 58 percent female in the general U.S. population), race (81 percent Caucasian in this sample, 81 percent for the general U.S. population), marital status (57 percent married in this sample, 55 percent in general U.S. population) and income (between \$25,000 and \$50,000 for both U.S. population and study sample). Also notable is that the study sample appears to have overrepresented persons meeting physical activity guidelines. The variable for meeting guidelines was created by using benchmark combinations of moderate and vigorous physical activity; as a result, the overrepresentation of vigorous exercisers or moderate exercisers in the sample could lead to overrepresentation of the number of persons who meet guidelines. Forty-one percent of the overall sample reported participating in vigorous activity, such as “running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel” at least once a week. Forty-four percent of the sample reported participating in moderate activity at least once a week, defined as anything that is “moderately energetic such as gardening, cleaning the car, walking at a moderate pace, dancing, floor or stretching exercises.” Both moderate

and vigorous physical activity are overrepresented in the current sample compared to the U.S. averages of 22 percent of older adults engaging in moderate activity and 60 percent of older adults not meeting guidelines (CDC, 2012; Federal Interagency Forum on Aging Related Statistics, 2010). Therefore these findings may present the upper bound of the impact of volunteering on meeting physical activity guidelines and suggest an urgent need to use more consistent measures of this construct across national longitudinal datasets.

B. Discussion of Individual Analyses

When examining volunteerism and baseline demographics consistent with data from the Bureau of Labor Statistics (BLS), older adults (OA) in the current sample were more likely to participate in formal volunteering if they were highly educated, had higher incomes, were currently married, and were female (BLS, 2012). Volunteers in the current sample were more likely to be retired and from the Midwest. Contrary to literature on formal volunteering, and inconsistent with the current sample of all volunteers, the subset of volunteers who reported volunteering with children (generative volunteers) were significantly more likely to be younger, female, not married, black, Hispanic, “other” race, from the South, and of lower income and education than volunteers who did not report volunteering with children. The significant difference in the profile of this subset of volunteers could provide important insights into how to recruit and enroll these individuals in intervention studies. Importantly, this profile is consistent with that of individuals who are less likely to report meeting physical activity guidelines.

Descriptive analyses for those who reported meeting guidelines at baseline were consistent with literature on physical activity showing participants who reported meeting

guidelines were mostly under 75, female, Caucasian, of higher education and income, married, employed, and from the West. The same profile was seen at the $p < .0001$ level of significance for those who reported vigorous and moderate intensities of physical activity at baseline. At the bivariate level, higher education; income category; and being married, Caucasian, and from the West increased the likelihood of meeting physical activity guidelines. In general these findings are consistent with prior literature on physical activity, but it should be noted that the present sample used unweighted demographic data for these measures, which could give an inaccurate estimate of comparability of the HRS sample to population estimates.

C. **Covariate Selection**

All known covariates of physical activity were examined and used as covariates in model selection including age, race, gender, marital status, retirement status, census region, education, and income. Potential covariates were assessed one at a time for significant association with the primary outcome variable (physical activity); those found to be significant at the 0.10 level were included as potential covariates in the complete model. Backwards-stepwise model selection was performed until all remaining covariates in each model were significant at the 0.05 level. Covariates included in the model were age, time, gender, race, income, education, marital status, census region, self-rated health, and retirement status.

D. **Multivariate Modeling**

1. **Primary Outcomes**

Longitudinal modeling with four-waves of observation revealed, as hypothesized, that volunteers were more likely to report meeting physical activity

guidelines over an eight-year period and across four waves of longitudinal data than non-volunteers. The entire sample became less likely to meet physical activity guidelines over time, but volunteers remained more likely than non-volunteers to meet guidelines in spite of declining likelihood to meet guidelines even while using random intercept modeling controlling for baseline physical activity. These findings indicate that volunteering may also have a protective effect for declines in physical activity over time. The findings of the present study are also consistent with findings from RCT's on Experience Corps volunteers which found, at four- and eight-month follow ups, that volunteering enhanced self-rated physical health and decreased functional dependency (Tan, Xue, Li, Carlson, and Fried, 2006). Although the same Experience Corp studies found no improvement on chronic health conditions among volunteers, the current study found that older adults who volunteer were less likely to report chronic conditions than non-volunteers at two-, four-, and six-year follow ups. Analyses from the current study also revealed that black volunteers were less likely than white volunteers to report meeting guidelines over the eight-year period. Over this period, higher income and education remained associated with likelihood to meet guidelines, as did being married living in the West. Decreases in self-reported health and increased age also resulted in a lower likelihood of meeting guidelines; however, again, volunteers remained consistently higher in likelihood to report meeting guidelines over time, even with volunteering assessed at one time point only. Persons who volunteered at baseline were not only more likely to meet physical activity guidelines in each year but were also more likely to report higher intensity physical activity than non-volunteers at each subsequent wave.

When the same relationship was examined for the subset of persons who

volunteered with children, no significant effect of volunteering with children and physical activity was found on meeting guidelines or increased physical activity intensity over time. However, when examining psychosocial characteristics or predictors of generative volunteering in 2008 were examined, several interesting associations were found. To examine theoretical predictors of volunteering with children such as age, life satisfaction, purpose in life, and quality of relationships as outlined by Socioemotional Selectivity Theory (SST), psychosocial variables from the psychosocial and lifestyle questionnaire were assessed. As predicted by SST those who volunteered with children had higher scores for purpose in life, life satisfaction, and social networks (social integration) at baseline. These findings were observed by Van Willigen (2000), for formal volunteers but have not been reported for generative volunteers. Interestingly, those who had lower scores on spousal social support were more likely to report volunteering with children than those who reported good relationships with their spouse. The same pattern emerged for those who reported negative relationships with children: those who had high social support scores with children were likely to volunteer with kids, but those who had negative were even more likely to volunteer with children. The same emerged for other family members, with positive relationships being correlated with volunteering with children, but an even greater association was seen among those who had high negative familial social support scores. There was no strong association between good relationships with friends and volunteering with children, but again, those who reported negative relationships with friends were more likely to volunteer with children. These findings present an interesting opportunity to explore whether volunteering for children can act as a buffer for negative social support. Finally, and contrary to SST, advanced

age was not a significant predictor of volunteering with children consistently across the years. Younger respondents were significantly more likely to volunteer with children.

2. Secondary Outcomes

Cross-sectional analyses were performed to examine each of the secondary outcomes at the 2008, 2010, and 2012 waves. Secondary outcomes of interest included functional limitations, self-reported health status, and depression. The additional series of three-wave cross-sectional models were developed for the variables missing 2014 RAND data so that an in-depth analysis of at least six years of participant behavior could be examined at three different time points.

An analysis of volunteer status (y/n) and secondary outcomes revealed strong associations for volunteering and reduction or absence of depressive symptoms at every time point based on CES-D composite scores at each wave. Volunteers also had fewer functional limitations including mobility indices (e.g., balance, timed walk tests), large muscle indices, ADLs, gross motor and fine motor, as well as lower change scores in all of these measures, meaning they were less likely to report a decrease in their functional status over time as well as less likely to report functional limitations. Volunteers were also less likely than non-volunteers to report comorbid conditions at each time point as well as a decreased change in self-reported health. When the same analysis was run based on volunteer intensity similar results were seen. High intensity volunteers reported fewer functional limitations, lower depression scores and better self-reported health at each time point than both non-volunteers and those who volunteered at lower intensities. These findings confirm findings from Morrow-Howell and colleagues from secondary data analysis of three waves of data from the Americans Changing Lives Survey. This survey

was designed to examine behaviors of adult volunteers and found that older adults who volunteered and engaged in more hours of volunteering scored significantly higher on three independent measures: functional dependency, self-reported health, and depression. To my knowledge the present study is the first to use HRS data to directly examine the impact of volunteering on depression, functional limitations, and self-reported health as well as chronic conditions at multiple time points. The present study also used nationally representative data with systematic oversampling of minority populations, had larger sample sizes and more waves of data than the previous study by Morrow-Howell and colleagues and was able to take advantage of the longitudinal data using more up to date multilevel modeling techniques and procedures in SAS.

Finally a similar analysis was run for the subset of persons who volunteered with children. This analysis found that persons who volunteered with children reported significantly fewer ADL and fine motor limitations, than volunteers who did not work with children. This finding could reflect the younger age range of those who volunteered with children and the likelihood that a person with fine motor and mobility limitations might be less likely to want to volunteer with children. Again, this study confirms a positive association between volunteering and self-reported health, depression, and functional limitation but is to my knowledge the first study to use data on volunteering with children from the HRS to directly examine the impact of volunteering with children on depression, functional limitations and self-reported health as well as chronic conditions at multiple time points.

E. **Summary and Study Implications**

Of the five study hypotheses, three were supported by the findings. Formal

volunteering was positively associated with engagement in physical activity and older adults who volunteered were more likely to meet guidelines for recommended amounts of physical activity. Formal volunteering was also positively associated with sustained physical activity across four waves of longitudinal data with a strong association seen between volunteering and meeting physical activity guidelines as well as higher physical activity intensity across four waves of data. Volunteering was also significantly associated with improved secondary outcomes including fewer functional limitations, lower depression scores, and better self-reported health across three time points. Benefits of volunteering including physical activity, functional status, self-reported health, and reduction or absence of depressive symptoms appear to have a linear relationship with each increment of increased volunteer intensity up to greater than 200 hours. No drop off or “volunteer burden” reported by other literature was observed in this study.

Volunteering with children may result in some secondary benefit including reduction or absence of depressive symptoms as well as fewer functional limitations, but no significant effect of volunteering with children on depression or overall functional limitations over time was observed. However, volunteering for children may confer additional psychosocial benefits and even act as a buffer for negative familial and friend-related social support consistent with the relationship suggested by SST. However, the subset of volunteers who worked with children tended to be younger in contrast to SST which posits that as adults age they are more likely to partake in volunteer opportunities with younger generations. It should be noted, however, that the question on volunteering with children was the only indicator of volunteering with younger generations in the dataset. Thus, it is conceivable that other volunteers had unmeasured opportunities to

volunteer with younger generations that were not accurately captured with this singular question. Also of note is the similar profiles seen for those who are significantly less likely to report meeting physical activity guidelines and those who report volunteering with children. This finding lends insight into how to target these typically hard to reach populations including people from the South, non-Hispanic blacks, Hispanics, those of lower income and education levels, and widows. Overall, these findings answer the question of whether volunteering can be used as a mechanism to engage older adults to become and remain more physically active as they age, suggest that volunteering with children could add additional benefit and perhaps buffer negative effects of diminished or limited social networks within the aging population, and suggest that volunteering with children could be an effective way to target typically harder to reach populations for physical activity interventions.

F. **Limitations and Future Research**

Several limitations should be considered when interpreting these results. First, there are several measurement limitations associated with the variables used for analysis. The measures for physical activity intensity may overestimate actual levels of physical activity and may not be consistent with current guidelines. Second, the physical activity questions rely entirely on self-report of physical activity behaviors over the past year. Previous studies of the validity of self-report suggest that, “reliability depends on factors such as the questionnaire used; participants’ age; and the type, duration, and intensity of activities measured” (He, 2005). The validity of the HRS physical activity questions has not been exhaustively examined but has recently been assessed by comparison to direct measurement of physical activity and is relatively consistent with accelerometer data

insofar as changes from baseline to follow up were similar and enable researchers to examine the changes in PA levels relatively accurately. Additionally, questions asked about physical activity are similar to questions used in other validated measures (He, 2005). Third, variables used from the leave behind are potentially subject to sampling bias. The leave behind variables include volunteering with children and some measures of moderate physical activity and are asked of only half of the survey respondents and only at every other wave, making reporting from respondents inconsistent and rendering half of the data missing at each wave due to eligibility. However, the sample for the leave behind is also a randomly selected sample, which limits bias due to sample selection leaving only the bias that would result from differential response to the questionnaire, which did not occur with these data. Fourth, the only available measure to test generativity theory or generative volunteering was in the leave behind and was captured only as volunteering with youth. This is by no means an inclusive measure of generativity but was the only available measure. Fifth, though longitudinal analyses can identify possible causal pathways and help designate areas of attention for future intervention studies, they are not causal analyses and thus cannot definitively identify the directionality of the observed relationships. As a result, selection bias cannot be ruled out. It is possible that adults who were more active to begin with were more likely to volunteer and thus likely to continue to be more active after volunteering as well. In this case, the observed effect would not be a result of volunteer status but reflect that the sample of volunteers was more active at baseline than non-volunteers. The present analyses sought to control for this effect by accounting for baseline physical activity in longitudinal models and comparing mean changes in physical activity. However, it is still

possible that the observed differences in the physical activity outcome for volunteers and non-volunteers were not a result of volunteering. Additionally, secondary outcome variables were analyzed cross-sectionally, which further limits the ability to infer directionality. Finally, it is possible that the people who had non-missing data at all four time points differed systematically from those who did not. However, the number of persons in these analyses with missing data on these variables was very small, minimizing this threat to the validity of the findings. The selection of one participant per house could also bias the sample, but since the selection was accomplished randomly it is less likely to lead to compromised mathematical rigor and helped to diminish the likelihood of correlations between members of households.

The analyses reported here lead to several recommendations for future research on this topic. First, future research should consider testing these same relationships through a causal analysis that uses more rigorous measures of both volunteering and physical activity where available. Second, generativity theory should be explored in much greater depth using a data set with a larger set of more applicable measures of generativity. Third, further tests of psychosocial variables in this data set as predictors of volunteer type and intensity should be explored. Finally, after causal analyses have been performed, an RCT to test the impact of volunteering and generative volunteering on the physical activity of older adults should be designed.

G. **Conclusions**

This is the first study of its kind to directly assess the impact of volunteering on physical activity using mathematically rigorous multilevel modeling of longitudinal data across four time periods. The present study also used study variables to test the impact

of volunteering on meeting CDC and ACSM guidelines as a benchmark using a nationally representative sample of adults aged 50 and older in the United States. Study findings suggest that older adults are indeed more likely to meet guidelines if they volunteer and, moreover, that they remain more likely than non-volunteers to meet guidelines over time even as likelihood to meet guidelines decreases overall. These findings begin to clarify the associations between volunteering and physical activity in older adults. Results suggest that there is a strong association between volunteering and physical activity in both meeting guidelines of physical activity and performing higher intensity of physical activity and that, secondary, physical activity outcomes vary as a function of the intensity of volunteering. Future research should directly examine this relationship from a causal perspective using an RCT to assess the potential for volunteering to be a mechanism to help older adults engage in and sustain higher levels of physical activity as they age.

APPENDICES

APPENDIX A

Coding Sheet and Guidelines Volunteering and Physical Activity in Older Adults Systematic Review Coding Guidelines

CONTENT CONVENTIONS

Definition of Volunteering: Formal volunteering only; does not include informal help to family and friends, caregiving, and assisting neighbors.

Includes: (1) assistance provided through organizations, either mutual-benefit associations in which the beneficiary is the membership (e.g., professional and union groups) or (2) community-oriented service organizations that benefit clients or others outside the organization (churches, religious organizations, fraternal groups); (3) actual assistance that benefits others; (4) focus on contributions to the collective good; (5) any activity where help is provided to younger generations in a volunteer mentor setting (help in schools, after school programs, boys and girls clubs, YMCA, etc.)

Excludes: programs that (1) offer payment in return for services; (2) require remote volunteering that does not involve social interaction or attendance somewhere; (3) require sedentary service (e.g., placing phone calls, stuffing envelopes, etc.)

Definition of Physical Activity: Any bodily movement produced by skeletal muscles that requires energy expenditure (WHO, 2014). Will include any of the following: walking for exercise, exercise, hiking, jogging, biking, exercise cycle, aerobics, aerobic dance, calisthenics/ general exercise, swimming; leisure activity (golf, bowling, dancing); household chores involving PA (gardening, raking, mowing lawn); activity level (reported in comparison to peers); vigorous exercise; moderate exercise. Measures of gait speed, measures of stairs climbed, blocks walked. Will exclude mention of physical health where no activity is measured (such as in quality of life, self-rated health, general health and well-being scores—if no specific measure of PA is listed, it will not be included).

CODING CONVENTIONS

- This document includes a series of appendices that contain information to be used in coding certain variables, e.g., study types, and to thoroughly evaluate the quality of the studies being coded. The appendices are a work in progress and will continue to expand as more information is collected.
- Clarification/definition and instruction will be denoted by parentheses.
- Whenever the guideline *Select all that apply* appears, code only the responses that apply with the value of 1. For the guideline *Code all that apply*, use the specific

APPENDIX A (continued)

- code values indicated in parentheses.
- Whenever the response choice “Other” is selected for any question, a written description should be entered. In some cases, multiple written responses need to be provided.
 - Missing values should be denoted by a question mark.
 - For qualitative variables, the response choice *unable to tell* should be used whenever the information required to determine the appropriate substantive response choice is not available.

CODING RELIABILITY CONVENTIONS

- Given the small number of studies to begin with each coder should manually highlight the RefID of the third study coded and continue doing so for every second study from that point. The selected studies will later be coded by the remaining coders to evaluate inter-coder reliability.

SYSTEMATIC REVIEW CODING SECTIONS

- 1) REPORT CHARACTERISTICS**
- 2) SETTING CHARACTERISTICS**
- 3) PARTICIPANT AND SAMPLE CHARACTERISTICS**
- 4) PROGRAM CHARACTERISTICS**
 - a. VOLUNTEER MEASURES**
- 5) PHYSICAL ACTIVITY MEASURES**
- 6) OUTCOME MEASURES**

APPENDIX A (continued)

Report Characteristics

1. What is the study ID number?
2. What was the first author's last name? (First six letters; enter ? if you can't tell)
3. What was the year of appearance of the report or publication (? if you can't tell) Page found _____
4. What type of report was this?
 - 1= Journal article
 - 2= Book or book chapter
 - 3= Dissertation
 - 4= Thesis
 - 5= Conference paper
 - 6= Unpublished manuscript or report
 - 7= Other
 - ?= Unable to tell
5. Was this peer reviewed?
 - 0= No
 - 1= Yes
6. What type of organization produced this report?
 - 1= University
 - 2= Government entity (specify) _____
 - 3= Contract research firm (specify) _____
 - 4= Other (specify) _____
 - ?= Unable to tell
7. Was this research funded?
 - 0= No
 - 1= yes
 - ?= Unable to tell
- 7a. If yes, who was the funder?
 - 1= Federally funded (specify) _____
 - 2= Privately funded (specify) _____
 - 3= Other (specify) _____
8. What was the data source of the study?
 - 1= First hand data
 - 2= Secondary data
 - Name of public dataset _____
9. What was the sampling strategy?
 - 1= Probability sampling
 - 2= Non-probability sampling
 - ?= Unable to tell
10. What methodology did the study employ?
 - 1= Randomized controlled trial
 - 2= Quasi-experimental design with a counterfactual framework (e.g., instrumental variable, propensity score matching)
 - 3= Traditional quasi-experimental design
 - 4= Cross-sectional

APPENDIX A (continued)

- 5= Longitudinal/prospective cohort studies
 6= Retrospective cohort studies
 7= Case control
 8= Other_____ (specify)
11. What theories or models were applied?
- a. Social support/Social networks
 - 0=NO
 - 1=Yes
 - b. Generativity
 - 0=NO
 - 1=Yes
 - c. SCT
 - 0=NO
 - 1=Yes
 - d. Role Theory
 - 0=NO
 - 1= YES
 - e. Other (specify)
12. What were the control variables included in analysis (please list below)
13. What were the statistical analyses performed in the study?
- 1= ANOVA
 - 2= ANCOVA
 - 3= Ordinary least regression
 - 4= Logistic regression
 - 5= Probit regression
 - 6= Structural equation modeling
 - 7= Multi-level modeling
 - 8= Longitudinal data analysis
 - 9= Other_____

Setting Characteristics

14. Which country were the participants in?
- 1= United States
 - 2= Canada
 - 3= European countries
 - 4= Eastern Asian countries
 - 5= Other Asian countries
 - 6= Africa
 - 7= Australia
 - 8= Other_____
15. If in the United States, what state was the study conducted in?
16. What type of community was the study conducted in?
- 1= Rural
 - 2= Urban

APPENDIX A (continued)

- 3= Suburban
 ?= Unable to tell

Participant and Sample Characteristics

17. What was the sample size in the study?
18. What was the age mean and range of the participants?
19. What was the cut-off age for older adults (if applicable)?
20. What is SES of sample?
21. What is Reported Health Status of sample?
22. What was the sex percentage in the sample?
 - 8= Female _____%
 - 9= Male _____%
 - ?= Unable to tell

Program Characteristics

23. What type of volunteering was assessed?
 - 1= Direct helping (lending help directly to a client, involves interaction with non-volunteer)
 - 2= Indirect helping (assisting in events, promotions, gardening, etc., not involved in direct assistance to client)
24. What type of clients were served (children, adults, those with disabilities, an organization)?
25. Was there an intergenerational component? (Was the older adult involved with a younger generation in their volunteer experience?)
 - 0= No
 - 1= Yes (describe)
26. Was there an opportunity for generative desire fulfillment? (Was OA allowed to give back to a younger generation in any way?)
 - 0= No
 - 1= Yes (describe)
27. Was there a physical activity component? (Were older adults required to walk, sit, and stand numerous times, lift objects or move them, was there any component that required the additional work of “any bodily movement produced by skeletal muscles that requires energy expenditure”?)
 - 0= No
 - 1= Yes (describe)
28. What was the duration of volunteering
 - 1= <1 hour per session/activity/outing
 - 2= 1-2 hours
 - 3= 3-4 hours
 - 4= 5-6 hours
 - 5= 7-8 hours
 - 6= >8 hours
 - 7= Can't tell
29. What was the intensity of the volunteering
 - 1= >3 times per week

APPENDIX A (continued)

- 2= 1-3 times per week
 - 3= 1-3 times per month
 - 4= 6-10 times per year
 - 5= <6 times per year
 - 6= Can't Tell
30. How did the authors measure volunteering?
31. Was evidence of reliability of this measure presented? Write down the statistics if provided.
- 8= No reliability analysis was performed
 - 9= Internal consistency
 - 10= Inter-rater reliability
 - 11= Test-retest correlation
 - 12= Split-half reliability
 - 13= Other_____
32. Was the reliability statistic satisfactory according to the rule of thumb (Cronbach of .70 or higher)?
- 8= Did not perform reliability analysis
 - 9= Poorly
 - 10= Moderately
 - 11= Strongly
33. Was evidence of validity of this measure presented?
- 8= No evidence at all
 - 9= Somewhat (e.g., indication of creating the items via collaboration with experts)
 - 10= Strong evidence (e.g., results from factor analysis)

Physical Activity Measures

34. What dimensions of physical activity were measured?
35. How did the authors measure physical activity?
36. Was evidence of reliability of this measure presented? Write down the statistics if provided.
- 8= No reliability analysis was performed
 - 9= Internal consistency
 - 10= Inter-rater reliability
 - 11= Test-retest correlation
 - 12= Split-half reliability
 - 13= Other_____
37. Was the reliability statistic satisfactory according to the rule of thumb (Cronbach of .70 or higher)?
- 8= Did not perform reliability analysis
 - 9= Poorly
 - 10= Moderately
 - 11= Strongly
38. Was evidence of validity of this measure presented?
- 8= No evidence at all

APPENDIX A (continued)

- 9= Somewhat (e.g., indication of creating the items via collaboration with experts)
 10= Strong evidence (e.g., results from factor analysis)

Outcome Measures (to be repeated multiple times with multiple outcome measures)

39. What Physical Activity outcomes were measured in the study?

- Physical Activity
- Walking for exercise
- Household chores (comprised of moderately strenuous housework, mowing the lawn, raking)
- Exercise (hiking, jogging, biking, exercise bike, aerobics/ aerobic dance, calisthenics/ general exercise, and swimming)
- Recreational activity (dancing, bowling, and golf)
- Activity level (Active= at least 10 episodes in last two weeks of moderate PA of at least 30 min in duration. Low activity= less than above)

8= Gait or walking speed

9= Sit, stand test

10= Flights of stairs?

40. How were the health outcomes mentioned above measured?

- 8= Attitude/perception scale
 - i. Used a standardized/established instrument
 - ii. Created a new instrument

9= Self-reported behaviors (frequency/amount/history)

10= Task performance

11= Hospital record

12= Other_____

41. Was evidence of reliability of this measure presented?

8= No reliability analysis was performed

9= Internal consistency

10= Inter-rater reliability

11= Test-retest correlation

12= Split-half reliability

13= Other_____

42. Was evidence of validity of this measure presented?

8= No evidence at all

9= Somewhat (e.g., indication of creating the items via collaboration with experts)

10= Strong evidence (e.g., results from factor analysis)

43. Write down the sign (+/-) of the volunteering/PA relationship, p value/confidence intervals, effect size, and the related health variables if available.

1= PA

2= Vol

+ = yes

- = no or absent

APPENDIX B

QUALITY ASSESSMENT TOOL

(PLEASE USE THIS TOOL TO DOUBLE CHECK AND FORMALLY ASSESS THE QUALITY OF THE CODED STUDIES)

QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1. Very likely
2. Somewhat likely
3. Not likely
4. Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1. 80 - 100% agreement
2. 60 - 79% agreement
3. less than 60% agreement
4. Not applicable
5. Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

- 1 Randomized controlled trial
- 2 Controlled clinical trial
- 3 Cohort analytic (two groups pre + post)
- 4 Case-control
- 5 Cohort (one group pre + post [before and after])
- 6 Interrupted time series
- 7 Other specify _____
- 8 Can't tell

Was the study described as randomized? If NO, go to Component C

No Yes

APPENDIX B (continued)

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

- 1 Yes
- 2 No
- 3 Can't tell

The following are examples of confounders:

- 1 Race
- 2 Sex
- 3 Marital status/family
- 4 Age
- 5 SES (income or class)
- 6 Education
- 7 Health status
- 8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design [e.g., stratification, matching] or analysis).

- 1 80 - 100% (most)
- 2 60 - 79% (some)
- 3 Less than 60% (few or none)
- 4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

- 1 Yes
- 2 No
- 3 Can't tell

APPENDIX B (continued)

(Q2) Were the study participants aware of the research question?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS**(Q1) Were data collection tools shown to be valid?**

- 1 Yes
- 2 No
- 3 Can't tell

(Q2) Were data collection tools shown to be reliable?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS**(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?**

- 1 Yes
- 2 No
- 3 Can't tell
- 4 Not Applicable (i.e., one-time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study (if the percentage differs by groups, record the lowest).

- 1 80 - 100%
- 2 60 - 79%
- 3 Less than 60%
- 4 Can't tell
- 5 Not Applicable (i.e., retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

APPENDIX B (continued)

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

- 1 80 - 100%
- 2 60 - 79%
- 3 Less than 60%
- 4 Can't tell

(Q2) Was the consistency of the intervention measured?

- 1 Yes
- 2 No
- 3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

- 4 Yes
- 5 No
- 6 Can't tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

- 1 Yes
- 2 No
- 3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e., intention to treat) rather than the actual intervention received?

- 1 Yes
- 2 No
- 3 Can't tell

GLOBAL RATING

COMPONENT RATINGS

Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	Selection Bias	Strong	Moderate	Weak
		1	2	3
B	Study Design	Strong	Moderate	Weak
		1	2	3
C	Confounders	Strong	Moderate	Weak
		1	2	3
D	Blinding	Strong	Moderate	Weak
		1	2	3

APPENDIX B (continued)

E	Data Collection Method	Strong	Moderate	Weak
		1	2	3
F	Withdrawals and Dropouts	Strong	Moderate	Weak
		1	2	3
				Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

- | | | |
|---|----------|----------------------------|
| 1 | STRONG | (no WEAK ratings) |
| 2 | MODERATE | (one WEAK rating) |
| 3 | WEAK | (two or more WEAK ratings) |

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

If yes, indicate the reason for the discrepancy

- | | |
|---|---|
| 1 | Oversight |
| 2 | Differences in interpretation of criteria |
| 3 | Differences in interpretation of study |

Final decision of both reviewers (circle one):

- | | |
|----------|-----------------|
| 1 | STRONG |
| 2 | MODERATE |
| 3 | WEAK |

APPENDIX C

TABLE XII: CODEBOOK OF VARIABLES

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
ID and person number	HHIDPN		RAND O
Household type	hhtyp	1="1.Single R" 2="2.2 R HHold" 3="3.Couple, 1 resp"	RAND O
Cohort	cohort	1="1.Ahead " 2="2.Coda" 3="3.Hrs" 4="4.War babies" 5="5.Early BB"	CORE/ RAND O
Nursing hm status	NURSHM	1="1.Interviewed in Nhm" 3="3.Observed in Nhm (no ivw)" 5="5.Interviewed in community" 6="6.Sp reports not in Nhm (no ivw)" 7="7.Observed not in Nhm (no ivw)" 9="9.Unknown"	RAND
Birthdate: year	birthyr		CORE
Respondent current age calculation	la019	continuous	CORE
Census region	RWCENREG	1="Northeast" 2="Midwest" 3="South" 4="West" 5="Other"	RAND
Gender	Gender	1="Male" 2="Female"	RAND

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Race	race	0="Unknown" 1="White/Caucasian" 2="Black/Afr.Amer" 7="Other"	RAND
Hispanic yes or no	hispan	0="Not Hispanic" 1="Hispanic"	RAND
Retirement Status	REMP	0= not retired 1= retired only 2= retired and other employment . = missing	CORE/RAND
Annual household income past year	HHINC (HINC_CAT)	1="Less than 25,000" 2="25,000-50,000" 3="50,000-75,000" 4="75,000-100,000" 5="Greater than 100,000"	RAND
<i>Volunteering Variables</i>			
Volunteer work in last 12 months	lg086	1="YES" 5="NO" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
Tot hrs. vol work 100	lg195	1="LESS THAN 100 HOURS" 3="ABOUT 100 HOURS" 5="MORE THAN 100 HOURS" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
Tot hrs. vol work 200	lg196	1="LESS THAN 200 HOURS" 3="ABOUT 200 HOURS" 5="MORE THAN 200 HOURS" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Tot hrs. vol work 50	lg197	1="LESS THAN 50 HOURS" 3="ABOUT 50 HOURS" 5="MORE THAN 50 HOURS" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
Often volunteer youth	LLB001B	1="DAILY" 2="SEVERAL TIMES A WEEK" 3="ONCE A WEEK" 4="SEVERAL TIMES A MONTH" 5="AT LEAST ONCE A MONTH" 6="NOT IN THE LAST MONTH" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE-LB
Often do any other volunteer or charity work	LLB991C	1="DAILY" 2="SEVERAL TIMES A WEEK" 3="ONCE A WEEK" 4="SEVERAL TIMES A MONTH" 5="AT LEAST ONCE A MONTH" 6="NOT IN THE LAST MONTH" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE-LB
Self-rated health	LC001	1="EXCELLENT" 2="VERY GOOD" 3="GOOD" 4="FAIR" 5="POOR" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
Functional Limitations			
Mobility Summary Score	RwMOBILA		Mobility Summary Score
Large Muscle	RwLGMUSA		RAND
Activities of Daily Living	RwADLA		RAND

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Gross Motor Skills	RwGROSSA		RAND
Fine Motor Skills	RwFINEA		RAND
Number of Health Conditions	RWCONDE		RAND
Body Mass Index	RwBMI		RAND
Change in Self-Reported Health Score	RwSHLTC		RAND
Self-Report of Health Change	RwHLTC		RAND
<i>Change in Functional Limitations</i>			RAND
Change in ADL	RwADLC		RAND
Change in Gross Motor Skills	RwGROSSC		RAND
Change in Fine Motor Skills	RwFINEC		RAND
Depression	RwCESD		RAND
<i>Primary Outcome Variable</i>			
Physical Activity			
Play sport or ex	llb001q	1="DAILY" 2="SEVERAL TIMES A WEEK" 3="ONCE A WEEK" 4="SEVERAL TIMES A MONTH" 5="AT LEAST ONCE A MONTH" 6="NOT IN THE LAST MONTH"	CORE-LB
Walk 20 min or more at a moderate pace	llb001r	1="DAILY" 2="SEVERAL TIMES A WEEK" 3="ONCE A WEEK" 4="SEVERAL TIMES A MONTH" 5="AT LEAST ONCE A MONTH" 6="NOT IN THE LAST MONTH"	CORE-LB
How often vigorous activity	lc223_	1="MORE THAN ONCE A WEEK" 2="ONCE A WEEK" 3="ONE TO THREE TIMES A MONTH" 4="HARDLY EVER OR NEVER" 7="(VOL) EVERY DAY" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
How often moderate activity	lc224_	1="MORE THAN ONCE A WEEK" 2="ONCE A WEEK" 3="ONE TO THREE TIMES A MONTH" 4="HARDLY EVER OR NEVER" 7="(VOL) EVERY DAY" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
How often mild activity	lc225_	1="MORE THAN ONCE A WEEK" 2="ONCE A WEEK" 3="ONE TO THREE TIMES A MONTH" 4="HARDLY EVER OR NEVER" 7="(VOL) EVERY DAY" 8="DK (Don't Know)/ NA (Not Ascertained)" 9="RF (Refused)"	CORE
SST VARIABLES			
Subjective Well-being			
Q3 Life Satisfaction			
Q03a In most ways my life is close to ideal.	llb003a	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Neither agree nor disagree, 5=Slightly agree, 6=Somewhat agree, 7=Strongly agree	CORE-LB
Q03b The conditions of my life are excellent.	llb003b	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Neither agree nor disagree, 5=Slightly agree, 6=Somewhat agree, 7=Strongly agree	CORE-LB
Q03c I am satisfied with my life.	llb003c	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Neither agree nor disagree, 5=Slightly agree, 6=Somewhat agree, 7=Strongly agree	CORE-LB
Q03d So far, I have gotten the important things I want in life	llb003d	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Neither agree nor disagree, 5=Slightly agree, 6=Somewhat agree, 7=Strongly agree	CORE-LB
Q03e If I could live my life again, I would change almost nothing	llb003e	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Neither agree nor disagree, 5=Slightly agree, 6=Somewhat agree, 7=Strongly agree	CORE-LB
Q35 Purpose in life – Psychological well-being			
Q35a I enjoy making plans for the future and working to make them a reality.	llb035a	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Q35b My daily activities often seem trivial and unimportant to me.	llb0035b	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Q35c I am an active person in carrying out the plans I set for myself.	llb0035c	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Q35d I don't have a good sense of what it is I'm trying to accomplish in life.	llb0035d	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Q35e I sometimes feel as if I've done all there is to do in life.	llb0035e	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Q35f I live life one day at a time and don't really think about the future.	llb0035f	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Q35g I have a sense of direction and purpose in my life.	llb0035g	1=Strongly disagree, 2=Somewhat disagree, 3=Slightly disagree, 4=Slightly agree, 5=Somewhat agree, 6=Strongly agree	CORE- LB
Quality of Social Ties		SCALING: Reverse-code items 35 b, d, e, and f and then average the scores across items to create an index of well-being (ranging from 1-6), with a high score indicating positive well-being. Set the final score to missing if there are more than three items with missing values.	
Q06 How close is your relationship with your spouse or partner?	llb006	1=Very close, 2=Quite close, 3=Not very close, 4=Not at all close	CORE- LB
Q10 How many of your children would you say you have a close relationship with?	llb010	Respondent gives number	CORE- LB
Q14 How many of these family members would you say you have a close relationship with?	llb014	Respondent gives number	CORE- LB
Q18 How many of your friends would you say you have a close relationship with?	llb018	Respondent gives number	CORE- LB
Social network composition			
Q04 Do you have a husband, wife, or partner with whom you live?	llb004	1=Yes, 5=No	CORE- LB
Q07 Do you have any living children?	llb007	1=Yes, 5=No	CORE- LB

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Q11 Do you have any other immediate family, for example, any brothers or sisters, parents, cousins, or grandchildren?	llb011	1=Yes, 5=No	CORE- LB
Q15 Do you have any friends?	llb015	1=Yes, 5=No	CORE- LB
		SCALING: Create a sum variable by counting the number of “yes” responses for respondents in order to obtain the composition of social networks. Scores will range from 0-4.	
Perceived Social Support (relationship quality)			
Q05 Perceived support from spouse			
Positive Social Support (items a-c)			
Q05a How much do they really understand the way you feel about things?	llb005a	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q05b How much can you rely on them if you have a serious problem?	llb005b	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q05c How much can you open up to them if you need to talk about your worries?	llb005c	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Negative Social Support (d-g)			
Q05d How often do they make too many demands on you?	llb005d	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q05e How much do they criticize you?	llb005e	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q05f How much do they let you down when you are counting on them?	llb005f	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q05g How much do they get on your nerves?	llb005g	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Q08 Perceived support from children			
Positive Social Support (items a-c)			
Q08a How much do they really understand the way you feel about things?	llb008a	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q08b How much can you rely on them if you have a serious problem?	llb008b	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q08c How much can you open up to them if you need to talk about your worries?	llb008c	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Negative Social Support (d-g)			
Q08d How often do they make too many demands on you?	llb008d	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q08e How much do they criticize you?	llb008e	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q08f How much do they let you down when you are counting on them?	llb008f	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q08g How much do they get on your nerves?	llb008g	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12 Perceived support from family			
Positive Social Support (items a-c)			
Q12a How much do they really understand the way you feel about things?	llb012a	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12b How much can you rely on them if you have a serious problem?	llb012b	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12c How much can you open up to them if you need to talk about your worries?	llb012c	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Negative Social Support (d-g)			
Q12d How often do they make too many demands on you?	llb012d	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12e How much do they criticize you?	llb012e	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12f How much do they let you down when you are counting on them?	llb012f	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q12g How much do they get on your nerves?	llb012g	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16 Perceived support from friends			
Positive Social Support (a-c)			
Q16a How much do they really understand the way you feel about things?	llb016a	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16b How much can you rely on them if you have a serious problem?	llb016b	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16c How much can you open up to them if you need to talk about your worries?	llb016c	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Negative Social Support (d-g)			
Q16d How often do they make too many demands on you?	llb016d	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16e How much do they criticize you?	llb016e	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16f How much do they let you down when you are counting on them?	llb016f	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB
Q16g How much do they get on your nerves?	llb016g	1=A lot, 2=Some, 3=A little, 4=Not at all	CORE- LB

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
		SCALING: Reverse code all items. Create an index of positive social support and an index of negative social support for each relationship category by averaging the scores within each dimension [positive (a-c) and negative (d-g)]. Set the final score to missing if there is more than one item with missing values for the positive social support scale, or more than two items with missing values for the negative social support scale.	
Q09 Frequency of contact with children			
Q09a Meet up	llb009a	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
Q09b Speak on phone	llb009b	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
Q09c Email	llb009c	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
Q13 Frequency of contact with other family members			
Q13a Meet up	llb013a	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
Q13b Speak on phone	llb013b	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
Q13c Email	llb013c	1=Three or more times a week, 2=Once or twice a week, 3=Once or twice a month, 4=Every few months, 5=Once or twice a year, 6=Less than once a year or never	CORE- LB
		SCALING: Create an index of loneliness by reverse-coding items 20a, 20b, 20c, and 20e and averaging the scores across all 11 items. Set the final score to missing if there are more than five items with missing values.	

APPENDIX C (continued)

TABLE XII: CODEBOOK OF VARIABLES (continued)

Measure	Variable (Rename)	Response Category (SAS CODE)	Source
Q29 Subjective age*			CORE- LB
Q29a What age do you feel?	llb029a	SCALING: Any age may be given	CORE- LB

APPENDIX D

TABLE XIII: INDEPENDENT VARIABLES

Item	Source	Year Asked	Level of Measurement and Range
Spent any time in the past 12 months doing volunteer work	Core	2008	Dichotomous
Total hours volunteer work	Core	2008	Categorical Less than 50 hrs. 50-100 hrs. 101-200 hrs. Greater than 200
Volunteer with children or young people	Core – Leave behind	2008	Dichotomous Y/N
Any other volunteer work	Core – Leave behind	2008	Dichotomous Y/N

APPENDIX E

TABLE XIV: SST VARIABLES

Socioemotional Variables	Descriptions	Score
Life Satisfaction	<p>Items: 5 items (Q03a – Q03e)</p> <ol style="list-style-type: none"> 1. Q03a In most ways my life is close to ideal. 2. Q03b The conditions of my life are excellent. 3. Q03c I am satisfied with my life. 4. Q03d So far, I have gotten the important things I want in life. 5. Q03e If I could live my life again, I would change almost nothing. 	<p>Create an index of life satisfaction by averaging the scores across all five items. Set the final score to missing if there are three or more items with missing values.</p> <p>Life Satisfaction Score =</p>
Social Network	The social integration question captures the degree of embeddedness in social networks (clubs, groups, etc.) in terms of the frequency of social interaction within this network.	
Social Integration	<i>Not including attendance at religious services, how often do you attend meetings or programs of groups, clubs, or organizations that you belong to?</i>	<p>1=More than once a week, 2=Once a week, 3=2 or 3 times a month, 4=About once a month, 5=Less than once a month, 6=Never</p> <p>Higher score correlates to LESS social integration – reverse score</p>
Quality of Relationships	Assessed by positive and negative social support questions in four dimensions: quality of spousal relationship, relationship with children, other family, and friends.	
Social Support	<p>Positive Social Support (items a-c)</p> <ol style="list-style-type: none"> a. How much do they really understand the way you feel about things? b. How much can you rely on them if you have a serious problem? c. How much can you open up to them if you need to talk about your worries? <p>Negative Social Support (items d-g)</p> <ol style="list-style-type: none"> d. How often do they make too many demands on you? e. How much do they criticize you? f. How much do they let you down when you are counting on them? g. How much do they get on your nerves? 	<p>Create an index of social support for each relationship category by averaging the scores within each dimension. Set the final score to missing if there is more than one item with missing values for the positive social support scale, or more than two items with missing values for the negative social support scale.</p>

APPENDIX F

TABLE XV: DESCRIPTIVE STATISTICS OF PHYSICAL ACTIVITY (MEETS/ DOES NOT MEET GUIDELINES) AT BASELINE

Variable	Does not meet requirements	Meets requirements	Total
Age (years) (p= .0005)	N (%)	N (%)	N (%)
50-59	1077 (24.62)	1008 (26.16)	2085
60-65	631 (14.42)	534 (13.86)	1165
66-70	865 (19.77)	824 (21.39)	1689
71-75	774 (17.69)	689 (17.88)	1463
76-80	513 (11.73)	434 (11.26)	947
81-85	307 (7.02)	252 (6.54)	559
>=86	307 (7.02)	252 (6.54)	320
Total	4375	3853	8228
Gender, n (%) (p < .0001)			
Female	3012 (68.85)	2265 (58.79)	5277
Race/ethnicity, n (%) (p < .0001)			
Non-Hispanic white	3420 (78.17)	3239 (84.06)	6659
Non-Hispanic black	804 (18.38)	499 (12.95)	1303
Non-Hispanic other	151 (3.45)	115 (2.98)	266
Total	4375	3853	8228
<i>(p= .0029)</i>			
<i>Not Hispanic</i>	<i>3923 (89.67)</i>	<i>3528 (91.59)</i>	<i>7451</i>
<i>Hispanic</i>	<i>452 (10.33)</i>	<i>324 (8.41)</i>	<i>776</i>
Education, n (%) (p < .0001)			
Less than high school	995 (22.75)	620 (16.09)	1615
GED	223 (5.10)	155 (4.02)	378
High school grad	1470 (33.62)	1085 (28.16)	2555

APPENDIX F (continued)

TABLE XV: DESCRIPTIVE STATISTICS OF PHYSICAL ACTIVITY (MEETS/ DOES NOT MEET GUIDELINES) AT BASELINE (continued)

Variable	Does not meet requirements	Meets requirements	Total
Some college	955 (21.84)	915 (23.75)	1870
College and above	730 (16.69)	1078 (27.98)	1808
Total	4373	3853	8226
Marital status, n (%) (p < .0001)			
Married	2182 (49.87)	2158 (56.02)	4340
Married, spouse absent	28 (.64)	23 (.60)	51
Partnered	121 (2.77)	127 (3.30)	248
Separated	86 (1.97)	67 (1.74)	153
Divorced	591 (13.51)	497 (12.90)	1088
Separated/Divorced	2 (.05)	1 (.03)	3
Widowed	1190 (27.20)	826 (21.44)	2016
Never married	175 (4.00)	153 (3.97)	328
Total	4375	3852	8227
Employment status, n (%) (P= .0223)			
Employed	2212 (50.62)	1831 (47.57)	4043
Retired	1844 (42.20)	1724 (44.79)	3568
Retired and employed	314 (7.19)	294 (7.64)	608
Total	4370	3849	8219
Census Region (p < .0001)			
Northeast	638 (14.59)	595 (15.45)	1233
Midwest	1110 (25.38)	998 (25.91)	2108
South	1898 (43.39)	1428 (37.07)	3326
West	720 (16.46)	825 (21.42)	1545
Other	8 (.18)	6 (.16)	14

APPENDIX F (continued)TABLE XV: DESCRIPTIVE STATISTICS OF PHYSICAL ACTIVITY (MEETS/
DOES NOT MEET GUIDELINES) AT BASELINE (continued)

Variable	Does not meet requirements	Meets requirements	Total
Total	4374	3852	8226
Income (p < .0001)			
< 25,000	1735 (39.66)	1099 (28.52)	2834
25,000-50,000	1189 (27.18)	1034 (26.84)	2223
50,000-75,000	625 (14.29)	625 (16.22)	1250
75,000-100,000	296 (6.77)	366 (9.50)	662
>100,00	530 (12.11)	729 (18.92)	1259
Total	4375	3853	8228

*P-values are based on results of chi square analyses on categorical outcome.

APPENDIX G

TABLE XVI: DESCRIPTIVE STATISTICS: PHYSICAL ACTIVITY INTENSITY AT BASELINE

Variable	Sedentary	Mild	Moderate	Vigorous	Total
Age (years) (p= < .0001)	N (%)	N (%)	N (%)	N (%)	N (%)
50-59	56 (18.06)	200 (21.23)	817 (22.69)	1012 (29.98)	2085
60-65	32 (10.32)	131 (13.91)	500 (13.89)	502 (14.87)	1165
66-70	46 (14.84)	182 (19.32)	725 (20.14)	736 (21.80)	1689
71-75	56 (18.06)	174 (18.27)	653 (18.14)	580 (17.18)	1463
76-80	42 (13.55)	116 (12.31)	458 (12.72)	331 (9.80)	947
81-85	34 (10.97)	79 (8.39)	290 (8.06)	156 (4.62)	559
>=86	44 (14.19)	60 (6.37)	157 (4.36)	59 (1.75)	320
Total	310	942	3600	3376	8228
Gender, n (%) (p < .0001)					
Female	202 (65.16)	750 (79.62)	2461 (68.36)	1864 (55.21)	5277
Race/ethnicity, n (%) (p < .0001)					
Non-Hispanic white	224 (72.26)	727 (77.18)	2876 (79.89)	2832 (83.89)	6659
Non-Hispanic black	77 (24.84)	177 (18.79)	602 (16.72)	447 (13.24)	1303
Non-Hispanic other	9 (2.90)	38 (4.03)	122 (3.39)	97 (2.87)	266
Total	310	942	3600	3376	8228
<i>(p= .0108)</i>					
<i>Not Hispanic</i>	269 (86.77)	845 (89.70)	3244 (90.14)	3093 (91.62)	7451
<i>Hispanic</i>	41 (13.23)	97 (10.30)	355 (9.86)	283 (8.38)	776
Education, n (%) (p < .0001)					
Less than high school	116 (37.42)	272 (28.87)	786 (21.84)	441 (13.07)	1615
GED	13 (4.19)	56 (5.94)	175 (4.86)	134 (3.97)	378
High school grad	90 (29.03)	319 (33.86)	1216 (33.79)	930 (27.56)	2555

APPENDIX G (continued)

TABLE XVI: DESCRIPTIVE STATISTICS: PHYSICAL ACTIVITY INTENSITY AT BASELINE (continued)

Variable	Sedentary	Mild	Moderate	Vigorous	Total
Some college	53 (17.10)	198 (21.02)	775 (21.53)	844 (25.01)	1870
College and above	38 (12.26)	97 (10.30)	647 (17.98)	1026 (30.40)	1808
Total	310	942	3599	3375	8226
Marital status, n (%) (p < .0001)					
Married	123 (39.68)	410 (43.52)	1764 (49.01)	2043 (60.52)	4340
Married, spouse absent	4 (1.29)	5 (.53)	24 (.67)	18 (.53)	51
Partnered	8 (2.58)	19 (2.02)	112 (3.11)	109 (3.23)	248
Separated	8 (2.58)	26 (2.76)	62 (1.72)	57 (1.69)	153
Divorced	34 (10.97)	138 (14.65)	493 (13.70)	423 (12.53)	1088
Separated/Divorced	0	0	2 (.06)	1 (.03)	3
Widowed	114 (36.77)	311 (33.01)	992 (27.56)	599 (17.74)	2016
Never married	19 (6.13)	33 (3.50)	150 (4.17)	126 (3.73)	328
Total	310	942	3599	3376	8227
Retired/Employment status, n (%) (P = 0. 8095)					
Employed	150 (48.54)	477 (50.69)	1737 (48.30)	1679 (49.78)	4043
Retired	135 (43.69)	400 (42.51)	1592 (44.27)	1441 (42.72)	3568
Retired and employed	24 (7.77)	64 (6.80)	267 (7.42)	253 (7.50)	608
Total	309	941	3596	3373	8219
Census Region (p < .0011)					
Northeast	48 (15.53)	149 (15.82)	571 (15.86)	465 (13.78)	1233
Midwest	68 (22.01)	239 (25.37)	940 (26.11)	861 (25.51)	2108
South	148 (47.90)	402 (42.68)	1435 (39.86)	1341 (39.73)	3326
West	44 (14.24)	149 (15.82)	648 (18.00)	704 (20.86)	1545
Other	1 (.32)	3 (.32)	6 (.17)	4 (.12)	14
Total	309	942	3600	3375	8226
Income (p < .0001)					

APPENDIX G (continued)

TABLE XVI: DESCRIPTIVE STATISTICS: PHYSICAL ACTIVITY INTENSITY AT BASELINE (continued)

Variable	Sedentary	Mild	Moderate	Vigorous	Total
< 25,000	182 (58.71)	445 (47.24)	1380 (38.33)	827 (24.50)	2834
25,000-50,000	59 (19.03)	270 (28.66)	995 (27.64)	899 (26.63)	2223
50,000-75,000	36 (11.61)	107 (11.36)	533 (14.81)	574 (17.00)	1250
75,000-100,000	12 (3.87)	44 (4.67)	260 (7.22)	346 (10.25)	662
>100,000	21 (6.77)	76 (8.07)	432 (12.00)	730 (21.62)	1259
Total	310	942	3600	3376	8228

*P-values are based on results of chi square analyses on categorical outcome.

APPENDIX H

TABLE XVII: SPEARMAN CORRELATIONS OF VOLUNTEERING AND MEETS OR DOES NOT MEET PHYSICAL ACTIVITY GUIDELINES IN 2008

PA Requirements	Volunteer (NO)	Volunteer (YES)	Total
(p < .0001)	N (%)	N (%)	N (%)
Meets Requirements	2003 (40.52)	1850 (56.32)	3853
Does not Meet Requirements	2940 (59.48)	1435 (43.68)	4375
Total	4943	3285	8228

APPENDIX I

TABLE XVIII: SPEARMAN CORRELATIONS OF VOLUNTEERING AND
INTENSITY OF PHYSICAL ACTIVITY IN 2008

PA Intensity	Volunteer (NO)	Volunteer (YES)	Total
(p <.0001)	N (%)	N (%)	N (%)
Vigorous	1728 (34.96)	1648 (50.17)	3376
Moderate	2228 (45.07)	1372 (41.77)	3600
Mild	716 (14.49)	226 (6.88)	942
Sedentary	271 (5.48)	39 (1.19)	310
Total	4943	3285	8228

APPENDIX J

TABLE XIX: SPEARMAN CORRELATIONS OF VOLUNTEER STATUS AND
SECONDARY OUTCOMES

Correlation (95% CI) P value	2008	2010	2012
Self-Reported Health	-0.172 (-0.193, -0.151) < .0001	-0.206 (-0.227, -0.185) < .0001	-0.211 (-0.231, -0.190) < .0001
CESD	-0.146 (-0.167, -0.124) < .0001	-0.160 (-0.181, -0.138) < .0001	-0.166 (-0.187, -0.144) < .0001
Functional Status			
Fxnl Limits- Mobility index	-0.134 (-0.155, -0.113) < .0001	-0.172 (-.192839, -0.1509) < .0001	-0.182 (-0.203, -0.161) < .0001
Fxnl Limits- ADLs	-0.111 (-0.133, -0.090) < .0001	-0.14164 (-0.163, -0.120) < .0001	-0.169 (-0.190, -0.148) < .0001
Change in ADL	-0.022 (-0.0432, 0.0001) .0512	-0.035 (-0.056, -0.013) .0016	-0.041 (-0.063, -0.020) 0.0002
Fxnl Limits- Large Muscle Index	-0.131 (-0.152, -0.110) < .0001	-0.130 (-0.151, -0.109) < .0001	-0.130 (-0.151, -0.109) < .0001
Change in Gross Motor	-0.030 (-0.051, -0.008) 0.0069	-0.033 (-0.055, -0.012) 0.003	-0.045 (-0.066, -0.0233) < .0001
Change in Fine Motor	-0.019 (-0.040, 0.002) 0.0826	-0.021 (-0.043, .0004) 0.0539	-0.034 (-0.055, -0.012) 0.0023

APPENDIX J (continued)**TABLE XIX: SPEARMAN CORRELATIONS OF VOLUNTEER STATUS AND SECONDARY OUTCOMES (continued)**

Correlation (95% CI) P value	2008	2010	2012
Health Conditions Index	-0.084 (-.1054, -0.062) < .0001	-0.116 (-0.137, -0.095) < .0001	-0.108 (-0.129, -0.086) < .0001
Change in Self-Reported Health Score	0.006 (-0.015, 0.028) 0.5639	-0.011 (-0.032, 0.011) 0.3300	-0.005 (-0.027, 0.016) 0.6405
Self-Report of Health Change	-0.075 (-0.097, -0.0537) <.0001	-0.087 (-0.109, -0.065) <.0001	-0.099 (-0.120439, -0.077606) <.0001
BMI	-0.023 (-0.044, -0.001) 0.0391	-0.013 (-0.035, 0.008) 0.2247	0.00928 (-0.012440, 0.030981) 0.4025

*Secondary outcome analyses were done using spearman correlation coefficients for ordinal non-linear variables.

APPENDIX K

TABLE XX: SPEARMAN CORRELATIONS OF VOLUNTEER INTENSITY AND SECONDARY OUTCOMES

Correlation (95% CI) P value	2008	2010	2012
Self-Reported Health	-0.199 (-0.220, -0.177) <.0001	-0.222 (-0.243, -0.201) <.0001	-0.226 (-0.247, -0.205) <.0001
CESD	-0.16123 (-0.183, -0.140) <.0001	-0.17545 (-0.197, -0.153) <.0001	-0.180 (-0.202, -0.158) <.0001
Functional Status			
Fxnl Limits- Mobility index	-0.153 (-0.175, -0.131) <.0001	-0.182 (-0.203, -0.160) <.0001	-0.192 (-0.213 -0.171) <.0001
Fxnl Limits- ADLs	-0.124 (-0.146, -0.101) <.0001	-0.152 (-0.174, -0.130) <.0001	-0.175 (-0.196, -0.153) <.0001
Change in ADL	-0.026 (-0.048, -0.003) 0.0250	-0.042 (-0.064, -0.020) 0.0002	-0.037 (-0.059, -0.015) 0.0010
Fxnl Limits- Large Muscle Index	-0.130 (-0.145, -0.116) <.0001	-0.142 (-0.163, -0.120) <.0001	-0.139 (-0.161, -0.117) <.0001
Change in Gross Motor	-0.03590 (-0.058, -0.0133) 0.0018	-0.041 (-0.063, -0.019) 0.0003	-0.04549 (-0.068, -0.023) <.0001
Change in Fine Motor	-0.025 (-0.047, -0.002) 0.0311	-0.021 (-0.043, 0.002) 0.0691	-0.028 (-0.050, -0.006) 0.0136

APPENDIX K (continued)**TABLE XX: SPEARMAN CORRELATIONS OF VOLUNTEER INTENSITY AND SECONDARY OUTCOMES (continued)**

Correlation (95% CI) P value	2008	2010	2012
Health Conditions Index	-0.101 (-0.123, -0.079) <.0001	-0.124 (-0.146, -0.102) <.0001	-0.118 (-0.140, -0.096) <.0001
Change in Self-Reported Health Score	0.005 (-0.018, 0.027) 0.6670	-0.010 (-0.032, 0.012) 0.3768	-0.005 (-0.027, 0.017) 0.6578
Self-Report of Health Change	-0.085 (-0.107, -0.063) <.0001	-0.085 (-0.107, -0.063) <.0001	-0.102 (-0.124, -0.080) <.0001
BMI	-0.03240 (-0.055, -0.010) 0.0050	-0.016 (-0.040, 0.006) 0.1582	0.004 (-0.018, 0.026) 0.7240

APPENDIX L

TABLE XXI: SPEARMAN CORRELATIONS OF VOLUNTEERING WITH CHILDREN AND SECONDARY OUTCOMES

Correlation (95% CI) P value	2008	2010	2012
Self-Reported Health	-0.048 (-0.072, -0.024) <.0001	-0.107 (-0.132, -0.081) <.0001	-0.055 (-0.081, -0.030) <.0001
CESD	0.062 (0.013, 0.111) 0.0141	0.06561 (-0.001, 0.132) 0.0537	0.107 (0.034, 0.180) 0.0039
Functional Status			
Fxnl Limits- Mobility Index	0.041 (-0.008, 0.091) 0.1023	-0.006 (-0.073, 0.060) 0.8557	0.090 (0.0174, 0.162) 0.0150
Fxnl Limits- ADLs	0.058 (0.009, 0.108) 0.0209	0.020 (-0.047, 0.086) 0.5652	0.121 (0.050, 0.192) 0.0010
Change in ADL	-0.008 (-0.057, 0.042) 0.7668	0.040 (-0.030, 0.105) 0.2531	-0.003 (-0.076, 0.070) 0.9407
Fxnl Limits- Large Muscle Index	0.039 (0.002, 0.076) 0.0363	0.012 (-0.054, 0.079) 0.7130	0.053 (-0.020, 0.125) 0.1542
Change in Gross Motor	0.00006 (-0.050, 0.050) 0.9980	0.035 (-0.032, 0.101) 0.3070	-0.024 (-0.096, 0.050) 0.5218

APPENDIX L (continued)**TABLE XXI: SPEARMAN CORRELATIONS OF VOLUNTEERING WITH CHILDREN AND SECONDARY OUTCOMES (continued)**

Correlation (95% CI) P value	2008	2010	2012
Change in Fine Motor	-0.014 (-0.064, 0.035) 0.5717	0.008 (-0.060, 0.075) 0.8112	0.067 (-0.005, 0.140) 0.0691
Health Conditions Index	0.029 (-0.020, 0.080) 0.2445	0.02626 (-0.040293, 0.092548) 0.4393	0.07934 (0.006710, 0.151028) 0.0322
Change in Self-Reported Health Score	-0.007 (-0.060, 0.043) 0.7864	-0.017 (-0.083, 0.050) 0.6228	0.030 (-0.050, 0.099) 0.4725
Self-Report of Health Change	-0.032 (0.082, 0.0180) 0.2078	-0.005 (-0.071, 0.067) 0.8878	0.022 (-0.050, 0.095) 0.5475
BMI	0.125 (0.075, 0.174) <.0001	0.018 (-0.050, 0.084) 0.5998	0.069 (-0.003, 0.141) 0.0617

CITED LITERATURE

- American College of Sports Medicine. (2013). *ACSM's guidelines for exercise testing and prescription*. Lippincott Williams & Wilkins.
- Ayalon, L. (2008). Volunteering as a predictor of all-cause mortality: What aspects of volunteering really matter? *International Psychogeriatrics / IPA*, 20(5), 1000-1013. doi:10.1017/S1041610208007096; 10.1017/S1041610208007096.
- Barron, J. S., Tan, E. J., Yu, Q., Song, M., McGill, S., & Fried, L. P. (2009). Potential for intensive volunteering to promote the health of older adults in fair health. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 86(4), 641-653. doi:10.1007/s11524-009-9353-8; 10.1007/s11524-009-9353-8.
- Barron, J. S., Tan, E. J., Yu, Q., Song, M., McGill, S., & Fried, L. P. (2009). Potential for intensive volunteering to promote the health of older adults in fair health. *Journal of Urban Health*, 86(4), 641-653.
- Baumeister, R. F., & Leary, M. R. (1997). Writing narrative literature reviews. *Review of general psychology*, 1(3), 311.
- Blair, S. N., & Morris, J. N. (2009). Healthy hearts—and the universal benefits of being physically active: Physical activity and health. *Annals of Epidemiology*, 19(4), 253-256. doi: 10.1016/j.annepidem.2009.01.019.
- Booth, F. W., Roberts, C. K. and Laye, M. J. (2012). Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology*. 2:1143–1211.
- Bowles, H. R., FitzGerald, S. J., Morrow, J. R., Jackson, A. W., & Blair, S. N. (2004). Construct validity of self-reported historical physical activity. *American Journal of Epidemiology*, 160(3), 279-286.
- Cancelliere, C., Cassidy, J. D., Ammendolia, C., & Côté, P. (2011). Are workplace health promotion programs effective at improving presenteeism in workers? A systematic review and best evidence synthesis of the literature. *BMC Public Health*, 11, 395-xxx.
- Carstensen, L. L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science*, 4(5), 151-156.
- Castora-Binkley, M., Peronto, C. L., Edwards, J. D., & Small, B. J. (2013). A longitudinal analysis of the influence of race on cognitive performance. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, gbt112.

- Centers for Disease Control and Prevention. (2005). Adult participation in recommended levels of physical activity—United States, 2001 and 2003. *MMWR. Morbidity and Mortality Weekly Report*, 54(47), 1208.
- Centers for Disease Control and Prevention. (2008). Federal interagency forum on aging-related statistics. *Older Americans 2008: Key Indicators of Well-Being*.
- Chambré, S. M. (1987). *Good deeds in old age*. Lexington Books.
- Chodzko-Zajko, Wojtek J., Proctor, David N., Fiatarone Singh, Maria A., Minson, Christopher T., Nigg, Claudio R., Salem, George J., . . . American College of Sports Medicine. (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Medicine and Science in Sports and Exercise*, 41(7), 1510-1530. doi: 10.1249/MSS.0b013e3181a0c95c.
- Conn, V. S., Phillips, L. J., Ruppar, T. M., & Chase, J. D. (2012). Physical activity interventions with healthy minority adults: Meta-analysis of behavior and health outcomes. *Journal of Health Care for the Poor and Underserved*, 23(1), 59-80.
- Cooper, H. (2010). *Research synthesis and meta-analysis: A step-by-step approach* (4th ed.). Thousand Oaks, CA: Sage.
- Crimmins, E., Guyer, H., Langa, K., Ofstedal, M. B., Wallace, R., & Weir, D. (2008). Documentation of physical measures, anthropometrics and blood pressure in the Health and Retirement Study. *HRS Documentation Report DR-011*, 14, 47-59.
- DuBois, D. L., Portillo, N., Rhodes, J. E., Silverthorn, N., & Valentine, J. C. (2011). How effective are mentoring programs for youth? A systematic assessment of the evidence. *Psychological Science in the Public Interest*, 12(2), 57-91.
- Dunn, A. L., Marcus, B. H., Kampert, J. B., Garcia, M. E., Kohl III, H. W., & Blair, S. N. (1999). Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: A randomized trial. *JAMA*, 281(4), 327-334.
- Elsawy, B., & Higgins, K. E. (2010). Physical activity guidelines for older adults. *American Family Physician*, 81(1), 55-9.
- Erikson, E. H., & Erikson, J. M. (1998). *The life cycle completed (extended version)*. W.W. Norton & Company.
- Finkel, S. E. (1995). *Causal analysis with panel data* (No. 105). Sage.
- Fisher, G. G., Hassan, H., Rodgers, W. L., & Weir, D. R. (2012). Health and retirement study imputation of cognitive functioning measures: 1992–2010 early release. *Ann Arbor, MI: Survey Research Center*.

- Fried, L. P., Carlson, M. C., Freedman, M. M., Frick, K. D., Glass, T. A., Hill, M. J., . . . Zeger, S. (2004). A social model for health promotion for an aging population: Initial evidence on the Experience Corps model. *Journal of Urban Health*, 81(1), 64-78.
- Fried, L. P., Carlson, M. C., Freedman, M. M., Frick, K. D., Glass, T. A., Hill, M. J., . . . Zeger, S. (2004). A social model for health promotion for an aging population: Initial evidence on the Experience Corps model. *Journal of Urban Health*, 81(1), 64-78.
- Gerst, K., Michaels-Obregon, A., & Wong, R. (2011). The impact of physical activity on disability incidence among older adults in Mexico and the United States. *Journal of Aging Research*, 2011, 420714. <http://doi.org/10.4061/2011/420714>.
- Glass, T. A., Freedman, M., Carlson, M. C., Hill, J., Frick, K. D., Ialongo, N., . . . Fried, L. P. (2004). Experience Corps: Design of an intergenerational program to boost social capital and promote the health of an aging society. *Journal of Urban Health*, 81(1), 94-105.
- Gottlieb B. H., Gillespie A. A. (2008). Volunteerism, health, and civic engagement among older adults. *Can J Aging*. Winter;27(4):399-406.
- Gottlieb, B. H., & Gillespie, A. A. (2008). Volunteerism, health, and civic engagement among older adults. *Canadian Journal on Aging = La Revue Canadienne Du Vieillissement*, 27(4), 399-406. doi:10.3138/cja.27.4.399; 10.3138/cja.27.4.399.
- Greenfield, E. A., & Marks, N. F. (2004). Formal volunteering as a protective factor for older adults' psychological well-being. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 59(5), S258-S264.
- Gruenewald, T. L., Liao, D. H., & Seeman, T. E. (2012). Contributing to others, contributing to oneself: Perceptions of generativity and health in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 67(6), 660-665. doi:10.1093/geronb/gbs034; 10.1093/geronb/gbs034.
- Gruenewald, T. L., Liao, D. H., & Seeman, T. E. (2012). Contributing to others, contributing to oneself: Perceptions of generativity and health in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 67(6), 660-665.
- Gruenewald, T. L., Tanner, E. K., Fried, L. P., Carlson, M. C., Xue, Q. L., Parisi, J. M., . . . Seeman, T. E. (2015). The Baltimore Experience Corps Trial: Enhancing generativity via intergenerational activity engagement in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, gbv005.
- Hao, Y. (2008). Productive activities and psychological well-being among older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 63(2), S64-S72.
- Harris, A. H., & Thoresen, C. E. (2005). Volunteering is associated with delayed mortality in

- older people: Analysis of the longitudinal study of aging. *Journal of Health Psychology*, 10(6), 739-752. doi:10.1177/1359105305057310.
- Harris, A., Thoresen, C. (2005). Volunteering is associated with delayed mortality in older people: Analysis of the longitudinal study of aging. *J Health Psychol.* Nov;10(6):739-52.
- Hauser, R. M., & Willis, R. J. (2004). Survey design and methodology in the Health and Retirement Study and the Wisconsin Longitudinal Study. *Population and Development Review*, 209-235.
- Health and Retirement Study 2010 Core Final, Version 5.0. (December 2014). Data Description and Usage. Health and Retirement Study, *Ann Arbor, MI: Survey Research Center.*
- Hedeker, D., & Gibbons, R. D. (2006). *Longitudinal Data Analysis* (Vol. 451). John Wiley & Sons.
- Heeringa, S. G., & Connor, J. (1995). Technical description of the Health and Retirement Study sample design: HRS. *AHEAD documentation report DR-002.*
- Hendricks, J., & Cutler, S. J. (2004). Volunteerism and socioemotional selectivity in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 59(5), S251-S257.
- Hodes, R. J., & Suzman, R. (2007). Growing older in America: The Health and Retirement Study. *Bethesda: National Institute on Aging, National Institute of Health, US Department of Health and Human Services.*
- Hong, S., Morrow-Howell, N., Tang, F., & Hinterlong, J. (2009). Engaging older adults in volunteering: Conceptualizing and measuring institutional capacity. *Nonprofit and Voluntary Sector Quarterly*, 38(2), 200-219.
- Hughes, S. L., Leith, K. H., Marquez, D. X., Moni, G., Nguyen, H. Q., Desai, P., & Jones, D. L. (2011). Physical activity and older adults: Expert consensus for a new research agenda. *The Gerontologist*, 51(6), 822-832.
- Jenkins, K. R., Ofstedal, M. B., & Weir, D. (2008). Documentation of health behaviors and risk factors measured in the health and retirement study (HRS/AHEAD). *HRS Documentation Report DR-010.*
- Jenkinson, C. E., Dickens, A. P., Jones, K., Thompson-Coon, J., Taylor, R. S., Rogers, M., . . . Richards, S. H. (2013). Is volunteering a public health intervention? A systematic review and meta-analysis of the health and survival of volunteers. *BMC public health*, 13(1), 1-10.
- Jeste, D. V., Depp, C. A., & Vahia, I. V. (2010). Successful cognitive and emotional aging. *World Psychiatry*, 9(2), 78-84.

- Juster, F. T., & Suzman, R. (1995). An overview of the Health and Retirement Study. *Journal of Human Resources*, S7-S56.
- Konrath, S., Fuhrel-Forbis, A., Lou, A., & Brown, S. (2012). Motives for volunteering are associated with mortality risk in older adults. *Health Psychology*, 31(1), 87.
- Li Y., Ferrano K. (2006). Volunteering in middle and later life: Is health a benefit, barrier or both? *Soc Forces*, 85(1):497-519.
- Librett, J., Yore, M. M., Buchner, D. M., & Schmid, T. L. (2005). Take pride in America's health: Volunteering as a gateway to physical activity. *American Journal of Health Education*, 36(1), 8-13.
- Lum T., Lightfoot E. (2005). The effects of volunteering of the physical and mental health of older people. *Res Aging*, 27(1):31-55.
- Lum T., Lightfoot E. (2005). The effects of volunteering on the physical and mental health of older people. *Res Aging*, 27(1):31-55.
- Lum, T. Y., & Lightfoot, E. (2005). The effects of volunteering on the physical and mental health of older people. *Research on Aging*, 27(1), 31-55.
- Luoh, M., & Herzog, A. R. (2002). Individual consequences of volunteer and paid work in old age: Health and mortality. *Journal of Health and Social Behavior*, 43(4), 490–509.
- Macera, C. A., Jones, D. A., Yore, M. M., Ham, S. A., Kohl, H. W., Kimsey Jr, C. D., & Buchner, D. (2003). Prevalence of physical activity, including lifestyle activities among adults—United States, 2000-2001. *Morbidity and Mortality Weekly Report*, 52(32), 764-766.
- Markus, G. B. (1979). *Analyzing Panel Data* (Vol. 18). Sage Google Books.
- Martinson, M., & Minkler, M. (2006). Civic engagement and older adults: A critical perspective. *The Gerontologist*, 46(3), 318-324.
- McArdle, J. J., Fisher, G. G., & Kadlec, K. M. (2007). Latent variable analyses of age trends of cognition in the Health and Retirement Study, 1992-2004. *Psychology and Aging*, 22(3), 525.
- Morrow-Howell, N., Hinterlong, J., Rozario, P. A., & Tang, F. (2003). Effects of volunteering on the well-being of older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 58(3), S137-45.

- Morrow-Howell, N., Hinterlong, J., Rozario, P., & Tang, F. (2003). Effects of volunteering on the well-being of older adults. *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences*, 58(3), S137-45.
- Musick, M. A., Herzog, A. R., & House, J. S. (1999). Volunteering and mortality among older adults: Findings from a national sample. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 54(3), S173-S180.
- Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., . . . Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39(8), 1435.
- Norton, K., Norton, L., & Sadgrove, D. (2010). Position statement on physical activity and exercise intensity terminology. *Journal of Science and Medicine in Sport*, 13(5), 496-502.
- Nowell, W. B. (2014). *Human, Social and Cultural Capital Predictors of Early Baby Boomer Productivity in Mid-Life to Late Life: An Examination of Formal Volunteering Behavior*. Doctoral dissertation, Columbia University.
- Ofstedal, M. B., & Herzog, A. R. (2004). *The Effect of Lifestyle on Change in Cognitive Functioning Among the Oldest-Old*. HRS Research Memo, University of Michigan–Ann Arbor. Manuscript in preparation.
- Ofstedal, M. B., Fisher, G. G., & Herzog, A. R. (2005). Documentation of cognitive functioning measures in the Health and Retirement Study. *Ann Arbor, MI: University of Michigan*.
- Olson, J. A. (1999). Linkages with data from Social Security administrative records in the Health and Retirement Study. *Soc. Sec. Bull.*, 62, 73.
- Oman, D., Thoresen, C. E., & McMahon, K. (1999). Volunteerism and mortality among the community-dwelling elderly. *Journal of Health Psychology*, 4(3), 301-316.
- Onyx, J., & Warburton, J. (2003). Volunteering and health among older people: A review. *Australasian Journal on Ageing*, 22(2), 65-69.
- Onyx, J., & Warburton, J. (2003). Volunteering and health among older people: A review. *Australasian Journal on Ageing*, 22(2), 65-69.
- Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2010). Too much sitting: The population health science of sedentary behavior. *Exercise and Sport Sciences Reviews*, 38(3), 105-113. doi: 10.1097/JES.0b013e3181e373a2.
- Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Hillsdale, NJ: Erlbaum. pp. 164-179.

- Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: A practical guide*. Malden, MA: Blackwell Publishing. Chapters 3-6 and 9; Appendices 1, 3-5.
- RAND Center for the Study of Aging. (2014). *Complementing the Health and Retirement Study: RAND Versions of HRS Data*.
- Reynolds, G. (2014). Are you programmed to enjoy exercise? *NY Times*, Online publication, Retrieved on April 9, 2014. Retrieved from <http://well.blogs.nytimes.com/2014/04/09/are-you-programmed-to-enjoy-exercise/>.
- Roberts, M. D., Brown, J. D., Oberle, L. P., Heese, A. J., Toedebusch, R. G., Wells, K. D., . . . Booth, F. W. (2013). Phenotypic and molecular differences between rats selectively bred to voluntarily run high vs. low nightly distances. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 304(11), R1024-R1035.
- Roberts, M. D., Toedebusch, R. G., Wells, K. D., Brown, J. D., Cruthirds, C. L., Heese, A. J., . . . Booth, F. W. (2014). Nucleus accumbens neuronal maturation differences in young rats bred for low versus high voluntary running behavior. *The Journal of Physiology*, 592(10), 2119-2135.
- Rozario, P. A. (2006). Volunteering among current cohorts of older adults and baby boomers. *Generations*, 29(4):31-36.
- Seguin, R., Buchner, D. M., Liu, J. M., Allison, M., Manini, T., Wang, C. Y., . . . LaCroix, A. Z. (2014). Sedentary behavior and mortality in older women: The Women's Health Initiative. *American Journal of Preventive Medicine*, 46(2), 122-135. doi: 10.1016/j.amepre.2013.10.021.
- Servais, M. (2004). An elementary cookbook of data management using HRS data with SPSS, SAS and Stata examples. Survey Research Center Institute for Social Research, University of Michigan–Ann Arbor.
- Servais, M. A. (2010). Overview of HRS public data files for cross-sectional and longitudinal analysis. *Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan*. Retrieved from <http://hrsonline.isr.umich.edu/sitedocs/dmgt/OverviewofHRSPublicData.pdf>.
- Shmotkin, D., Blumstein, T., & Modan, B. (2003). Beyond keeping active: Concomitants of being a volunteer in old-old age. *Psychology and Aging*, 18(3), 602–607.
- Singer, J. D. (2002). Fitting individual growth models using SAS PROC MIXED. In D. S. Moskowitz & S. L. Hershberger (Eds.), *Modeling Intraindividual Variability with Repeated Measures Data: Methods and Applications* (pp. 135-170). Mahwah, NJ: Erlbaum.

- Singer, J. D. (2002). Using SAS PROC MIXED to fit multilevel models, hierarchical models, and individual growth models. *Journal of Educational and Behavioral Statistics*, 23, 323-355.
- Singer, J. D., & Willett, J. B. (2003). *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. Oxford University Press.
- Smith, J., Fisher, G., Ryan, L., Clarke, P., House, J., & Weir, D. (2013). Psychosocial and lifestyle questionnaire, 2006–2010. Documentation Report Core Section LB. Ann Arbor, MI: Survey Research Center, Institute for Social Research, University of Michigan.
- Sneed, R. S., & Cohen, S. (2013). A prospective study of volunteerism and hypertension risk in older adults. *Psychology and Aging*, 28(2), 578.
- Sneed, R. S., & Cohen, S. (2013). A prospective study of volunteerism and hypertension risk in older adults. *Psychology and Aging*, 28(2), 578.
- Sonnega, A., Faul, J. D., Ofstedal, M. B., Langa, K. M., Phillips, J. W., & Weir, D. R. (2014). Cohort Profile: the Health and Retirement Study (HRS). *International Journal of Epidemiology*, 43(2), 576-585.
- St. Clair, P., Blake, D., Bugliari, D., Chien, S., Hayden, O., Hurd, M., . . . Zissimopoulos, J. (2002). RAND HRS data documentation. *RAND Corporation, Santa Monica*.
- Strath, S. J., Kaminsky, L. A., Ainsworth, B. E., Ekelund, U., Freedson, P. S., Gary, R. A., ... & Swartz, A. M. (2013). Guide to the assessment of physical activity: Clinical and research applications A scientific statement from the American heart association. *Circulation*, 128(20), 2259-2279.
- Tan, E. J., Xue, Q. L., Li, T., Carlson, M. C., Fried, L. P. (2006). Volunteering: A physical activity intervention for older adults—The Experience Corps program in Baltimore. *J Urban Health*, 83(5):954-69.
- Tan, EJ., Xue, QL., Li, T., Carlson, MC., Fried, LP. (2006). Volunteering: A physical activity intervention for older adults—the Experience Corps program in Baltimore. *J Urban Health*, 83(5):954-69.
- Thomas, B. H., Ciliska, D., Dobbins, & M., Micucci, S. (2004). A process for systematically reviewing the literature: Providing the research evidence for public health nursing interventions. *Worldviews Evid-Based Nurs* 3rd quarter, 176-184.
- United States Department of Health and Human Services. (2008). Administration on Aging. *A Statistical Profile of Older Americans* 65.

- United States Department of Labor Bureau of Labor Statistics. (2014). *Volunteering in the United States, 2014*. Washington, DC: United States Department of Labor. USDL Publication 15-0280.
- United States Department of Labor Bureau of Labor Statistics. (2014) *Volunteers by Annual Hours of Volunteer Activities and Selected Characteristics*. Washington, DC: United States Department of Labor. USDL Publication 15-0280.
- Van Willigen, M. (2000). Differential benefits of volunteering across the life course. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 55(5), S308-S318.
- Warburton, J., Le Brocque, R., & Rosenman, L. (1998). Older people—The reserve army of volunteers?: An analysis of volunteerism among older Australians. *The International Journal of Aging and Human Development*, 46(3), 229-245.
- Wheeler, J.A., Gorey, K.M., & Greenblatt, B. (1998). The beneficial effects of volunteering for older volunteers and the people they serve: A meta-analysis. *Int J Aging Hum Dev*;47(1):69-79.
- Wilson, D. B. (2001). Practical meta-analysis effect size calculator. URL: <http://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-SMD1.php> [accessed 2014-01-23][WebCite Cache].
- Wilson, J. (2000). Volunteering. *Annual Review of Sociology*, 26(1), 215-240.
- Wilson, J. (2000). Volunteering. *Annual Review of Sociology*, 26(1), 215-240.
- World Health Organization. (2002). *The world health report 2002: Reducing risks, promoting healthy life*. World Health Organization.

JULIA ROSE CLARK

3915 N Janssen Ave, Apt 3S | Chicago, Illinois 60613 | (401) 368-5558 | jclark38@uic.edu

EDUCATION

University of Illinois at Chicago, School of Public Health

Doctor of Philosophy in Public Health Candidate, Community Health Sciences, Gerontology, expected Summer 2016

University of Illinois at Chicago, School of Public Health

Master of Public Health, Community Health Sciences, Gerontology, May 2012

Simmons College, Boston, MA

Bachelor of Science, Psychobiology, May 2006; Minors: Chemistry, Philosophy; Emphasis in Neurobiology and Pre-medicine Dean's List 2005-2006; Simmons College Judicial Board: President, 2005-06; National Division 3 Academic & Athletic Squad: member, 2006. Sigma Xi Scientific Research Society: elected associate member, 2006. American Chemical Society: member, National Honor Society: elected member

PROFESSIONAL EXPERIENCE

University of Illinois at Chicago, Chicago, IL
January 2011 – June 2015

Department of Medicine, Section of Digestive Diseases and Nutrition

Project Manager, Chicago Colorectal Cancer Consortium (CCCC)

- Recruit and enroll eligible subjects, collect demographic data, tissue, and blood samples
- Coordinate schedules, certifications and site audits at five hospitals, manage ten employees, create and disseminate site protocols and standard operating procedures for all sites

University of Illinois at Chicago, Chicago, IL
Fall 2013 – Present

School of Public Health

Teaching Assistant, Community Health Sciences

- *CHSC 480 Health Behavior and Health Promotion*
- *CHSC 460 Public Health Preparedness*
- *CHSC 430 Public Health Policy and Law*

Guest Lecturer

- *CHSC 446 Research Methodology*

Takeda Pharmaceuticals North America, Deerfield, IL
December 2008 – June 2010

Professional Sales Representative

- Promoted and sold three pharmaceutical products throughout the north and northwest Chicago suburbs
- Contributed to increasing market share by analyzing business trends, identified areas of opportunity, secured formulary status at local hospitals and fostered value-driven relationships with customers and office staff

Ravinia Associates Department of Gastroenterology, Highland Park, IL
December 2006 – December 2008

Patient Liaison/Gastroenterology Assistant

- Facilitates and triaged patient care, coordinated schedule for GI procedures, administered capsule endoscopy

COMMUNITY INVOLVEMENT

Chronic Disease Self Management Program (CDSMP), Chicago, IL
March 2011 – Present

Stanford University Certified Class Leader

Jewish United Fund, Chicago, IL
September 2011 – Present

Volunteer

Brooklyn Boulders, Chicago, IL
November 2014 – Present

Adaptive Climbing Volunteer

Mikva, Chicago, IL

July 2015 – Present

Youth Mentor, Volunteer

Chicago Commons, Chicago, IL

Executive Leadership Committee (CELC) Board Member
April 2016- Present

Professional memberships

American Public Health Association (APHA),
2011 – Present

American Society on Aging (ASA),
2011 – Present

Gerontology Society of America (GSA),
2011 – Present

PUBLICATIONS AND PRESENTATIONS

1. Xicola, R., Gagnon, M., Rawson, J., Pusatcioglu, C., **Clark, J.**, Janoski, A., Disharoon, A., Morrissey, K., Raheem, S., Mraz, K., Ravella, S., Moran, M., Ceryes, K., Mijic, D., Guzman, G., Abcarian, H., Blumetti, J., Cintron, J., Chaudhry, V., Corning, C., Kupfer, S., Melson, J., Freeman, V., Xie, H., Braunschweig, C., Ellis, N., Llor, X. (2012). *The Chicago Colorectal Cancer Consortium (CCCC) experience: understanding colorectal cancer disparities*. Digestive Disease Week, 2012.
2. Pusatcioglu, C., Nemeth, E., Fantuzzi, G., Llor, X., Freels, S., Tussing-Humphreys, L., Cabay, R., Linzmeier, R., Ng, D., **Clark, J.**, Braunschweig, C. (2014). Systemic and Tumor Level Iron Regulation in Men with Colorectal Cancer: a case control study. *Nutrition & Metabolism*, 11:21. DOI: 10.1186/1743-7075-11-21.
3. Clark, J (2012). Community Assessment for the Village of Lemont. Presented at the 2013 American Public Health Association Conference.
4. Xicola, Rosa M., **Clark, Julia R.**, Carroll, T., Alvikas, J., ; Marwaha, P., Regan, M., Emmadi, R., Alagiozian-Angelova, V., Kupfer, S., Ellis, N., Llor, X. (2016). *Unveiling*

new colorectal cancer phenotypes with mismatch repair deficiency. Digestive Disease Week, 2016.

5. Xicola, R. M., **Clark, J. R.**, Carroll, T., Alvikas, J., Marwaha, P., Regan, M., ... & Llor, X. (2016). 775 Unveiling New Colorectal Cancer Phenotypes With Mismatch Repair Deficiency. *Gastroenterology*, 150(4), S160.

RELEVANT COURSEWORK

- **Long Term Care Policy, Urban planning for the Aging Environment**, Public Health and Aging, Aging and the life course, Biostatistics, Epidemiology, Public Health Policy, Public Health Planning and Evaluation, Emergency Preparedness, Health Behavior Interventions, Grant writing, Survey methodology, Qualitative analysis, Longitudinal data analysis

CERTIFICATIONS AND TECHNICAL SKILLS

- IRB Human Subjects CITI Certification; CDSMP Certified Class Leader; Safe Animal Practices (by ASPCA), Radiation Safety; Proficient in Microsoft Word, Excel, PowerPoint, Outlook; Experience with SAS, SPSS; Proficient in Spanish; Emergency preparedness certified