Purpose in Life and Cardiovascular Health

by

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DEDICATION

“When nothing seems to help, I go and look at a stonecutter hammering away at his rock perhaps a hundred times without as much as a crack showing in it. Yet at the hundred and first blow it will split in two, and I know it was not that blow that did it, but all that had gone before.”

— Jacob A. Riis

To my parents. Two incredibly kind and persistent “stonecutters” who taught me so much through the way they live.

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"I came upon a crossroads where I sought only shelter for a brief time. But as I lay down my sack and kicked off my shoes, I noticed that this crossroads was like no other I had found. The air in this place held an inviting warmth and a vibrancy permeated all things. As I introduced myself to the travelers here, I felt no hesitation or discouragement but sincerity and optimism in their place. In their eyes I saw something I could not name but that felt very much like home. In this place, together, we shared and encouraged and rejoiced in the abundance of life. . . ."

— Derrick Carpenter

The poem above reflects how I feel about my time at Michigan. I thought I would be spending a short four years here to complete my Bachelors degree, but here I am ten years later. During my time here, I have had the privilege of meeting so many incredible people who continue to inspire me. As I look back on my time here I have so many people to thank.

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ABSTRACT

A growing body of research suggests that purpose in life may provide a point of intervention to improve the health behaviors and health of the large segment of adults throughout the world who are progressing into old age. Researchers have recently documented robust associations between purpose and enhanced health behaviors and outcomes. Preliminary studies also indicate that purpose can be systematically enhanced. Further research examining the connection between purpose, health behaviors, and outcomes is needed to guide the design of novel and low-cost prevention and intervention programs. To date, little research has investigated purpose in life's association with cardiovascular health or the possible mechanisms behind this link. In four distinct but linked papers, I use data from the Health and Retirement Study, a nationally representative sample of U.S. adults over the age of 51 to examine this research gap.

The first and second studies examined the connection between purpose and cardiovascular health. Each unit increase in purpose (on a 6-point scale) was longitudinally associated with a decreased risk of stroke (OR = 0.78, 95% CI = 0.67-0.91) and myocardial infarction (OR = 0.73, 95% CI = 0.57-0.93), even after adjusting for an array of covariates. The third study examined a potential mechanism behind the purpose and health connection and tested whether higher baseline purpose predicted increased use of six preventive health care services over time. Results showed that higher purpose predicted higher use of cholesterol tests, mammograms, pap smears, prostate exams, and colonoscopies, but not flu shots. The fourth

study used structural equation modeling to longitudinally examine if four health behaviors mediated the association between purpose and myocardial infarction. Results showed that only physical activity (β = -.026; 95% CI = -.042, -.009) and smoking (β = -.016; 95% CI = -.035, .004) mediated the association between purpose and myocardial infarction, while sleep quality and cholesterol tests did not. Taken together, these studies expand the literature by enhancing our knowledge about the association between purpose and cardiovascular health. These results are also the first to illuminate how health behaviors mediate the association between purpose and cardiovascular disease.

CHAPTER I

A Promising Approach

"There is much wisdom in the words of Nietzsche: "He who has a *why* to live for can bear almost any *how*."

— Viktor Frankl, *Mans Search for Meaning* (1959, Ch. II, p. 109)

Health researchers have historically focused on alleviating disease and dysfunction, including psychological dysfunction (e.g., depression, anxiety, anger). This focus has led to important discoveries and, in the last 100 years alone, quality of life has improved and life expectancy has increased by 30 years. The alleviation of disease and dysfunction will certainly continue enhancing and elongating lives, but this nation's population of older adults is rapidly expanding (the number of people aged 65+ is expected to double by 2030) and the Congressional Budget Office projects that spending on Medicare will nearly double as a share of GDP, from 3.7% in 2012 to 7.3% by 2050. Despite spending considerably more on health care than any other country in the world, U.S. adults rank poorly on several indicators of health and well-being (Avendano, Glymour, Banks, & Mackenbach, 2009; Woolf & Aron, 2013)

A growing body of research shows that one promising approach to addressing this critical need is by examining the potential health enhancing effects associated with positive psychological functioning (Boehm & Kubzansky, 2012; Ryff, Singer, & Love, 2004; Seligman, 2008). This body of research shows that in cross-sectional and longitudinal studies, various

facets of positive psychological functioning (e.g., optimism, life satisfaction, positive affect, purpose in life) are associated with an array of positive health behaviors, biomarkers, and health outcomes. Moreover, two recent meta-analyses of randomized controlled studies show that various facets of positive psychological functioning are modifiable (Bolier et al., 2013; Sin & Lyubomirsky, 2009). Therefore, with further research and proper tailoring, existing interventions that build positive psychological functioning could eventually become candidates for an innovative and inexpensive toolkit of exercises that enhance health and reduce health care costs among those moving into the ranks of this aging society. However, more basic research is needed to inform potential interventions.

Particularly for the large segment of this society that is progressing into old age, purpose in life—a strong motivational factor—may provide a point of intervention for increasing health behaviors and health. Though the precise definition of purpose in life varies among researchers, it is typically conceptualized as a core component of a person's life that helps generate a sense of directedness and meaning (McKnight & Kashdan, 2009; Ryff, 2014; Steger, Frazier, Oishi, & Kaler, 2006). The concept is often viewed as central to well-being and fulfillment in life (Baumeister, 1991; Burrow & Hill, 2011; Dik, Byrne, & Steger, 2013; Frankl, 2006; Heintzelman & King, in press; King & Napa, 1998; McKnight & Kashdan, 2009; Ryff & Singer, 2008; Ryff, 2014; Seligman, 2012; Steger, 2009; Strecher, 2013; Wong, 2013).

A small but growing body of cross-sectional and longitudinal studies show that purpose in life is linked with better health behaviors, biomarkers, and health outcomes (Roepke, Jayawickreme, & Riffle, 2013; Ryff, 2014). Further, randomized controlled trials have shown that purpose can be enhanced (Breitbart et al., 2012; Fava & Tomba, 2009; Ruini & Fava, 2012; van der Spek et al., 2014). However, in order for this area of research to advance, two important

gaps in the literature must be addressed. First, researchers have to examine if purpose in life is associated with cardiovascular and cerebrovascular illnesses, which are the leading causes of morbidity and death in the United States. Second, the mechanisms that may explain the association between purpose in life and physical health need further study.

My central thesis is that purpose in life is associated with enhanced cardiovascular and cerebrovascular health. Further, health behaviors are one pathway through which purpose in life may impact health. I begin by briefly describing the aims of my purpose in life research—the long-term vision of what I hope this research will amount to. I then discuss why cardiovascular and cerebrovascular illnesses are important outcome variables to examine. Then I discuss the definition of purpose in life and how the construct is measured. I also examine the psychometric properties of the purpose in life that will be used in the dissertation studies. I continue by discussing past research that has examined purpose in life in relation to physical health, followed by a section describing the limitations of this research and how it can be expanded. I end the chapter with a preview of the four dissertation studies that will be written.

Long-Term Vision

My long-term vision is to create a substantial body of research that helps support the translation of empirically tested exercises that bolster positive psychological functioning, into interventions that improve the health and health behaviors of older adults. These interventions will be simple, inexpensive, and inherently enjoyable to perform and ultimately self-reinforcing. Findings from the analyses of existing large datasets will be used to inform the modification of existing interventions that strengthen positive psychological functioning. The interventions will then be further tailored for different age groups, socioeconomic groups, and other forms of

identity that significantly impact the effectiveness of interventions. These tailored interventions will then be empirically tested and become candidates for an innovative strategy that improves health behaviors, lowers health care costs, and most importantly, improves the health and quality of life among those moving into the ranks of our aging society.

Why Target Cardiovascular and Cerebrovascular Health?

Cardiovascular disease is the number one cause of death in the United States and cerebrovascular disease is the number four cause of death. Annually, cardiovascular disease and cerebrovascular disease costs the United States $320.1 billion (Mozaffarian et al., in press). They both have several overlapping risk factors, many of which can be modified. At a practical level, they have straightforward and objective endpoints that make it easy for clinicians and researchers to determine if a cardiovascular or cerebrovascular event has occurred. For these reasons, they have become a model for other diseases and processes in research on aging. These are also reasons why psychologists in the past, who tried to alleviate psychological ill-being (e.g., depression, anxiety) in order to improve health, focused on cardiovascular disease.

A number of well-designed randomized controlled trials aimed at reducing psychological ill-being among middle aged and older cardiac patients have already been conducted. They examined the impact of these interventions on the likelihood of future cardiovascular events. These studies were conducted among people with existing cardiovascular conditions for practical reasons. The interventions are expensive and because cardiovascular events occur rarely among healthy samples, the number needed to treat would be too high. For this reason, these studies were conducted with cardiac patients instead of healthy populations.

Six large-scale randomized controlled studies examined how psychological interventions might improve the prognosis of middle aged and older cardiac patients. However, the evidence from these trial studies are mixed at best (Peterson & Kim, 2011). Several of these studies showed that interventions which focus on the alleviation of psychological ill-being do not provide cardiovascular benefits. Given that the absence of psychological ill-being does not indicate the presence of psychological well-being, identifying positive psychological factors linked with cardiovascular health may lead to innovative efforts. Therefore, in addition to focusing solely on the alleviation of psychological ill-being, what if we expanded the focus to include the enhancement of positive psychological functioning? Purpose in life is a ripe candidate, one that provides people with a strong motivational force and an incentive to engage in various behaviors.

Measuring Purpose in Life

Modern day purpose in life research builds upon the pioneers who first examined the psychological study of purpose in life including Viktor Frankl (1959), Carol Ryff (Ryff & Keyes, 1995), and Abraham Maslow (1970). Since the work of these pioneers, a multitude of measures have emerged to measure purpose in life. The construct is typically measured using self-report surveys (or sometimes interviews) under the assumption that a purposeful life is best understood from the point of view of the person who is living it.

Even today the exact definition of purpose in life somewhat varies among researchers. Further, the terms "purpose in life" and "meaning in life" are often used interchangeably—most purpose in life measures include the word meaning and most meaning in life measures include the word purpose (Heintzelman & King, in press). A recent review searched only English

publications in peer-reviewed journals and identified 59 unique scales that measure meaning and purpose in life (Brandstatter et al., 2012). The authors discussed their findings, noting that the scales "assess the extent of experienced meaning in life, the lack thereof, sources of meaning, search for, making of, commitment to and structure of meaning" (Brandstatter et al., 2012, p. 1048). They also found that the scales conceptualize the construct in various ways, which illuminates the fact that researchers do not agree on which elements best constitute the dimensions of purpose.

However, there are three definitions of the construct I have come to appreciate over the years. Ryff (2014) characterizes a person with high purpose in life as someone who: "has goals in life and a sense of directedness; feels there is meaning to present and past life; holds beliefs that give life purpose; and has aims and objectives for living." McKnight & Kashdan (2009) state that purpose is a "self-organizing life aim that organizes and stimulates goals, manages behaviors, and provides a sense of meaning." Finally, Damon, Menon, and Bronk (2003) state that purpose is "a stable and generalized intention to accomplish something that is at once meaningful to the self and of consequence to the world beyond the self." Seligman (2002) and Wong (1998) agree that purpose must be an intention to accomplish something of significance beyond the self.

Psychometric Properties of the Ryff Purpose in Life Scale

The psychometric properties of the purpose in life scale (the Ryff Purpose in Life Scale, a subscale of Ryff's Psychological Well-Being Scales (Ryff & Keyes, 1995)) used for the dissertation studies were examined. The examination of the scale was conducted using data from

the Health and Retirement Study, a nationally representative study of American adults over the age of 51.

Factor Structure

To examine the factor structure of the Ryff Purpose in Life Scale, exploratory factor analysis, using principal component analysis and varimax rotation was used. Factors with Eigen values larger than one were retained. Results from the factor analysis revealed a two-factor solution. The first factor accounted for 39% of the variance among the items and the second factor accounted for 17% of the variance among the items. Combined, both factors accounted for 56% of the variance among the items. The negatively worded items loaded onto factor 1 while the positively worded items loaded onto factor 2. The factor loadings of all seven items are displayed in Table 1.1. The lack of a one-factor solution is a common finding for scales that contain both positively and negatively worded items (Brown, 2003; Merritt, 2011; Rauch, Schweizer, & Moosbrugger, 2007; Spector, Katwyk, Brannick, & Chen, 1997; Weems, Onwuegbuzie, & Lustig, 2003). Further simulation studies show that even if 10% of responders are responding carelessly and do not pay attention to negatively worded items appropriately, one-factor solutions can be rejected in factor analyses (Woods, 2006). Future research should examine if the two factors that emerge in the Purpose in Life Scale are meaningfully different factors or a mere artifact of method bias.

Test-Retest Reliability

To examine the test-retest reliability of the Ryff Purpose in Life Scale, the correlation between the baseline purpose in life assessment and a subsequent purpose in life assessment that occurred four years later was examined. The test-rest correlation was r=0.61, suggesting that the Ryff Purpose in Life Scale is moderately stable over a period of several years.

Convergent Validity

To examine the convergent validity of the Ryff Purpose in Life Scale, the correlations between the purpose scale and several other psychosocial measures was examined (see Table 2.2). All correlations were in the expected direction. For example, the Purpose in Life scale was negatively correlated with depression, anxiety, cynical hostility, hopelessness, and loneliness. On the other hand, the Purpose in Life scale was positively correlated with mastery, life satisfaction, positive affect, and personal growth. Further the Purpose in Life scale was positively correlated with four of the Big-5 personality factors (e.g., conscientiousness, openness to experience, extraversion, agreeableness) and negatively correlated with neuroticism. Interestingly the correlations between the Purpose in Life Scale with religiosity/spirituality, social integration, and lifetime traumas were low.

Regardless of how it is operationalized, a growing body of cross-sectional and longitudinal research persistently demonstrates an association between purpose in life and a range of positive: health behaviors, biomarkers, neural correlates, and health outcomes. (Seligman, 2002; Wong, 2013)

Previous Research on Purpose in Life and Physical Health

Behavioral Health

Why might associations between purpose and health exist? Health behaviors that directly impact health may be one pathway through which people with higher purpose generally act in healthier ways. They partake in better preventive behaviors, acquire adequate relaxation, and also exercise more (Holahan & Suzuki, 2006; Holahan et al., 2011; Wells & Bush, 2002). One study tracked physical activity and exercise objectively using accelerometers and found that

higher purpose was associated with higher physical activity and exercise (Hooker & Masters, in press). Another study that examined purpose, religiosity, and health found that purpose was associated with healthier exercise, eating, smoking, and stress management habits—even after adjusting for demographic factors and church attendance (Homan & Boyatzis, 2010). In the arena of sleep, people with higher purpose also have fewer sleep problems, more optimal sleep duration, and less body movement during sleep, a marker of higher sleep quality (Hamilton, Nelson, Stevens, & Kitzman, 2007; Phelan, Love, Ryff, Brown, & Heidrich, 2010; Phelan et al., 2010; Steptoe, O'Donnell, Marmot, & Wardle, 2008).

Biological Health

Purpose has been linked with a broad array of biomarkers. For example, higher purpose has been linked with lower levels of interleukin-6 receptors, an inflammatory factor linked with a wide array of diseases and conditions including certain forms of cancer, cardiovascular disease, arthritis, and Alzheimer's (Friedman, Hayney, Love, Singer, & Ryff, 2007). Another study examined purpose in life's potential buffering effects. People with low socioeconomic status typically have a higher likelihood of impaired glycemic control (measured using glycosylated hemoglobin in this study), however purpose buffered this risk in low socioeconomic individuals (Tsenkova, Love, Singer, & Ryff, 2007). Among bereaved women participating in a distress-alleviating intervention, those showing greater increases in purpose displayed the greatest increases in natural killer cell activity – a marker of optimal immune functioning (Bower, Kemeny, Taylor, & Fahey, 2003). Higher purpose has also been linked with an array of other biomarkers including lower levels of salivary cortisol, higher levels of HDL (the "healthy" cholesterol), a lower waist-hip ratio, and healthier telomerase activity (Jacobs et al., 2011; Lindfors & Lundberg, 2002; Ryff et al., 2004).

Neural Health

Purpose has also been linked with a number of positive neural correlates. Neurally, researchers used functional magnetic resonance imaging (MRI) and found that higher purpose was negatively associated with middle temporal gyrus grey matter and positively associated with right insular cortex grey matter and (Lewis, Kanai, Rees, & Bates, 2013). In another study, MRI was used to examine how people's amygdala activation differed in response to neutral versus negative stimuli. People with higher purpose displayed increased ventral anterior cingulated cortex activation and reduced amygdala activation (van Reekum et al., 2007). Further, functional MRI scans from another study revealed that when people were shown positive stimuli, people with higher eudaimonic well-being (an umbrella term that includes purpose) displayed sustained ventral striatum and dorsolateral prefrontal cortex activity (Heller et al., 2013).

Physical Health

A growing body of research shows that higher purpose in life is associated with better health outcomes. Higher purpose has been linked with lower rates of mortality (Boyle, Barnes, Buchman, & Bennett, 2009; Hill & Turiano, in press; Sone et al., 2008; Tanno et al., 2009). It has also been linked with a reduced risk Alzheimer's disease onset and maintenance of functional status (Boyle, Buchman, & Bennett, 2010; Boyle, Buchman, Barnes, & Bennett, 2010). A key theme that weaves together all these findings is that purpose in life appears to be correlated with an expansive array of factors that influence the health of the body and mind including behavioral, biological, and neural health. However, for this area of research to advance, possible mechanisms that explain the link between purpose and health need further investigation.

Why Study Mechanisms?

Mechanisms are important to examine because they can be used as intermediate outcomes in trial studies. Intermediate outcomes are important because initial randomized controlled trial studies in new areas of research are small in scale, with short follow-up times. These small studies will not include enough participants who develop heart attacks, strokes, or other major (but rare) health outcomes that previous research in this area has examined. However, these small trial studies will have enough participants to detect changes in intermediate factors such as health behaviors (e.g., exercise frequency, medication adherence). Further, improvement in these intermediate outcomes can produce important health benefits. For example, accumulating evidence suggests that interventions which reduce obesity, hypertension, and diabetes among people aged 50 and older result in added years of life and reduced lifetime medical spending (Goldman et al., 2009). Midlife is an important life phase because it is often a time when people re-evaluate life priorities and change behaviors. Reasons for this re-evaluation and resulting behavior changes may include: a) a desire to avoid illnesses that afflicted their parents or contributed to the death of peers; b) a desire to see their grand children grow; c) a desire to enjoy a longer and healthier life as people begin considering retirement (J. Smith, personal communication, December 30, 2014). Although a small number of studies have examined the link between purpose in life and health behaviors, most possess one or more methodological limitations that can be improved upon.

Limitations of Previous Research

To build upon the important work of others, the methodological limitations of past research need to be addressed. A review of past literature generally reveals one or more of the

following four limitations: Studies are generally 1) cross-sectional in design, 2) have relatively homogenous samples, 3) likely suffer from sampling bias, 4) and use non-optimal statistical tests. 1) With cross-sectional studies, directionality is difficult to determine. Does higher purpose in life cause better health behaviors or do better health behaviors cause higher purpose in life? Although the use of longitudinal data cannot isolate causality, this type of data does allow for a stronger causal inference. 2) Past studies used relatively homogenous samples that are not generalizable to the wider population (e.g., undergraduate students taking surveys for psychology class credit, mostly White samples, samples of only one gender). 3) Many previous studies likely suffer from potential sampling bias, making it more difficult for researchers to generalize results to the wider population. Examples of such studies include studies that recruited patients only from: an undergraduate psychology class, a local health clinic, or participants who were recruited into a study for particular reasons (e.g., the Terman study, where people were selected into the study because of high standardized intelligence test scores as children). 4) Past studies that link purpose in life with health behaviors have used mostly cross-sectional data and correlation or regression. However, no study has directly tested if health behaviors mediate the relationship between positive psychological functioning and health using structural equation modeling. This statistical framework allows researchers to decompose effects and simultaneously test multiple mediating pathways, which is important because it helps avoid confounded mediation. This framework also allows researchers to determine the relative magnitude of specific indirect effects. Further, it allows researchers to examine direct and indirect effects between an independent and dependent variable. Therefore, examining potential mechanisms using longitudinal data, in a hetereogenous sample, that does not suffer from sampling bias, and the use of appropriate statistics would help advance the literature.

Preview of Studies

The first and second study in this dissertation will examine the connection between purpose in life and cerebrovascular and cardiovascular health in people over age 50. The first study will examine if higher baseline purpose in life is associated with decreased incidence of stroke over time among people who are free of stroke at baseline. This study, along with all the other studies in this dissertation will use the most rigorous statistical and epidemiological methods available to approximate causality. In incidence studies for example, psychological functioning will be assessed prior to disease onset. Further, the studies will statistically adjust for traditional risk factors (e.g., demographic factors) along with psychological dysfunction (e.g., depression) in order to demonstrate that positive psychological functioning shows a unique association. Previous randomized controlled studies examining the effect of psychological interventions on cardiovascular outcomes were conducted among cardiac patients for practical reasons (as explained before). Further, the National Heart Lung and Blood Institute notes that people with cardiac conditions have greatly increased vulnerability to additional cardiovascular events and need interventions to decrease this vulnerability (Eagle et al., 2010). In this context, the second study asks if purpose in life is associated with a lower risk of myocardial infarction among people with existing cardiovascular disease.

The third and fourth study will examine mechanisms that may help explain the link between purpose in life and physical health in general. The third study will examine if higher baseline purpose in life is associated with increased use of six preventive health care services (flu shots, cholesterol tests, colonoscopies, mammograms, pap smears, and prostate exams) over time. While only cholesterol tests are directly associated with risk of cardiovascular disease, if

evidence confirms that higher purpose in life is associated with a greater likelihood of engaging most of these preventive health care services, such results may indicate people's overarching outlook on preventive behaviors. The final study will use structural equation modeling to longitudinally examine if healthier sleep, smoking, exercise, and preventive health care behaviors mediate the association between positive psychological functioning and cardiovascular disease.

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Table 1.1 Factor loadings of items on the Ryff Purpose in Life Scale

	Factor 1	Factor 2
1. I enjoy making plans for the future and working to make them a reality		0.76
2. My daily activities often seem trivial and unimportant to me*	0.67	
3. I am an active person in carrying out the plans I set for myself		0.82
4. I don't have a good sense of what it is I'm trying to accomplish in* life	0.71	
5. I sometimes feel as if I've done all there is to do in life*	0.74	
6. I live life one day at a time and don't really think about the future*	0.66	
7. I have a sense of direction and purpose in my life		0.75

*Negatively worded items were reverse coded

Table 1.2. Correlation of Ryff Purpose in Life Scale (+ individual scale items) with other psychological factors

	Full Scale	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7
Depression	-0.33	-0.21	-0.23	-0.19	-0.20	-0.25	-0.15	-0.22
Anxiety	-0.32	-0.18	-0.23	-0.20	-0.22	-0.25	-0.12	-0.21
Cynical Hostility	-0.26	-0.11	-0.19	-0.10	-0.20	-0.33	-0.14	-0.10
Negative Affect	-0.45	-0.27	-0.33	-0.25	-0.29	-0.43	-0.19	-0.30
Hopelessness	-0.53	-0.29	-0.38	-0.24	-0.36	-0.29	-0.30	-0.30
Loneliness	-0.38	-0.22	-0.27	-0.20	-0.26	-0.02	-0.18	-0.26
Lifetime Traumas	-0.04	-0.04	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02
Mastery	0.39	0.33	0.21	0.31	0.23	0.23	0.15	0.30
Life Satisfaction	0.34	0.26	0.21	0.24	0.20	0.19	0.11	0.30
Positive Affect	0.44	0.32	0.30	0.31	0.26	0.28	0.14	0.35
Personal Growth	0.68	0.26	0.42	0.39	0.43	0.48	0.37	0.44
Religiosity/Spirituality	0.09	0.32	0.06	0.08	0.06	0.02	-0.02	0.12
Optimism	0.36	0.43	0.21	0.27	0.20	0.20	0.11	0.35
Social integration	0.14	0.10	0.07	0.12	0.07	0.10	0.05	0.09
Conscientiousness	0.42	0.29	0.28	0.34	0.28	0.21	0.20	0.27
Openness to Experience	0.40	0.32	0.22	0.31	0.25	0.23	0.20	0.25
Extraversion	0.40	0.30	0.26	0.33	0.21	0.23	0.16	0.30
Agreeableness	0.30	0.22	0.21	0.20	0.18	0.18	0.12	0.22
Neuroticism	-0.31	-0.21	-0.23	-0.21	-0.21	-0.22	-0.07	-0.25

Item 1 – I enjoy making plans for the future and working to make them a reality
Item 2 – My daily activities often seem trivial and unimportant to me
Item 3 – I am an active person in carrying out the plans I set for myself
Item 4 – I don't have a good sense of what it is I'm trying to accomplish in life
Item 5 – I sometimes feel as if I've done all there is to do in life
Item 6 – I live life one day at a time and don’t really think about the future
Item 7 – I have a sense of direction and purpose in my life

CHAPTER II

Purpose in life and reduced stroke in older adults: The Health and Retirement Study

This chapter is adapted from my original paper "Purpose in life and reduced stroke in older adults: The Health and Retirement Study" (Kim, Sun, Park, & Peterson, 2013).

Introduction

Chronic diseases cause an immense amount of social, financial, and personal burden. As researchers uncover the links between psychological factors and physical health, the search for psychological factors linked with disease onset intensifies. The logic behind this search is, that the identification of such psychological factors may lead to innovative prevention and treatment efforts.

One condition, stroke, is especially costly for the US health care system. The prevalence of stroke among U.S. adults is roughly 7 million, with approximately 795,000 new cases reported annually (Roger et al., 2011). In addition, the estimated direct cost of the condition in 2007 was $25.2 billion (Roger et al., 2011). Because the risk for stroke increases with age, the identification of health-promoting constructs is particularly important for the expanding segment of older American adults facing the dual threat of declining health and rising health care costs.

While past research has mostly examined the detrimental impact of negative psychological states or traits (e.g., depression and anxiety) on health outcomes (Kubzansky & Kawachi, 2000; May et al., 2002; Pan, Sun, Okereke, Rexrode, & Hu, 2011), researchers have

more recently begun investigating how positive psychological characteristics (e.g., optimism and positive emotions) protect against illness and promote physical health, healthy behaviors, and longevity (Boehm, Peterson, Kivimaki, & Kubzansky, 2011; Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007; Kim, Park, & Peterson, 2011; Ostir, Markides, Black, & Goodwin, 2000; Peterson, Park, & Kim, 2012; Pressman & Cohen, 2005; Rasmussen, Scheier, & Greenhouse, 2009; Steptoe, O'Donnell, Marmot, & Wardle, 2008; Xu & Roberts, 2010). Among these positive psychological characteristics, purpose in life is a construct that contemporary psychologists have studied because of its potential to predict and promote better health (Boyle, Barnes, Buchman, & Bennett, 2009; Frankl, 2006; Maslow, 1962; McKnight & Kashdan, 2009; Peterson, 2006; Ryff & Keyes, 1995). Greater purpose has been associated with a reduced risk of Alzheimer's disease (Boyle, Buchman, Barnes, & Bennett, 2010), reduced risk of heart attack among individuals with coronary heart disease (Kim, Sun, Park, Kubzansky, & Peterson, 2013), and increased longevity in both American and Japanese samples (Boyle et al., 2009; Tanno et al., 2009). The definition of purpose in life varies throughout the field, but it is usually conceptualized as an individual's sense of directedness and meaning in his or her life (Steger, Frazier, Oishi, & Kaler, 2006). The term "purpose in life" and "meaning in life" are often used interchangeably in the literature.

While prospective studies examining the association between purpose in life and cerebrovascular disease are uncommon, one recent study of 2,959 Japanese respondents found an association between a one-item purpose in life measure and reduced stroke mortality over a 13-year follow-up (Koizumi, Ito, Kaneko, & Motohashi, 2008). Their analyses split purpose into a low or high category, and their multivariate model adjusted for five covariates: age, history of hypertension, history of diabetes, smoking habit, and perceived stress. However, further

longitudinal research studies are needed to understand the relationship between purpose and cerebrovascular health.

In the present study, we extended existing work by using data from the Health and Retirement Study to examine the relationship between purpose in life and stroke in a nationally representative sample of American adults over the age of 50. In contrast to the study just described, we used a well-validated measure of purpose in life and controlled for a wider range of covariates, including several psychosocial variables that have been linked to stroke. We also examined stroke incidence rather than only stroke mortality.

We hypothesized that among older adults, higher purpose in life, as measured by Ryff and Keyes' Scales of Psychological Well-Being (Ryff & Keyes, 1995), would be associated with lower risk of stroke, even after adjusting for potential confounds. In order to examine the potential impact of covariates, we adjusted for sociodemographic, behavioral, biological, and psychosocial factors. We evaluated whether any observed effects between purpose and reduced stroke reflected the presence of other positive psychosocial constructs (optimism, positive affect, social participation) or the absence of negative psychological factors (anxiety, cynical hostility, depression, and negative affect) (Kim et al., 2011; Kubzansky & Kawachi, 2000; May et al., 2002; Ostir et al., 2000; Pan et al., 2011; Pressman & Cohen, 2005; Rasmussen et al., 2009; Xu & Roberts, 2010).

Method

Participants

The Health and Retirement Study (HRS) is a nationally representative panel study that has been surveying more than 22,000 Americans aged 50 and older every two years since 1992

(Wallace & Herzog, 1995). We used psychological and covariate data collected in the eighth wave (2006), along with occurrences of stroke reported in the ninth wave (2008), tenth wave (2010), and during exit interviews. For respondents who died between 2006 and 2010, knowledgeable informants completed exit interviews and specified the respondent's cause of death. The University of Michigan's Institute for Social Research is responsible for the study and provides extensive documentation about the protocol, instrumentation, sampling strategy, and statistical weighting procedures(Wallace & Herzog, 1995).

Procedure

In 2006, approximately 50% of HRS respondents were randomly chosen and visited for an enhanced face-to-face interview. In order to prevent selection bias, the randomization and selection of respondents was carefully conducted by the coordinators of HRS. These respondents were asked to complete a self-report psychosocial questionnaire. The response rate was 90%. While HRS interviewed all couples in a household, only those 50 and older were included in the HRS database. Therefore, among those who were interviewed face-to-face, 7,169 individuals were eligible for HRS at baseline. We excluded 430 individuals with a self-reported history of stroke at baseline, resulting in a final sample of 6,739 respondents. We present demographic characteristics of study participants in Table 2.1.

Measures

Self-reported health measures used in HRS have been rigorously assessed (Wallace & Herzog, 1995).. Self-reported health conditions have also shown substantial agreement with medical records (Okura, Urban, Mahoney, Jacobsen, & Rodeheffer, 2004).

Stroke Outcome Measurement

We defined stroke incidence as a first nonfatal or fatal stroke based on self or proxy-report of a physician's diagnosis using 2008, 2010, or exit survey data. Transient ischemic attacks are usually not conceptualized as full strokes in incidence studies because their symptoms are fleeting. Strokes that are assessed through self or proxy report correspond imperfectly with medical records. Although imperfect, the high correlation between self-reported strokes and hospital records has been well documented (Bergmann, Byers, Freedman, & Mokdad, 1998; Bots et al., 1996; Engstad, Bonaa, & Viitanen, 2000; Glymour & Avendano, 2009; Okura et al., 2004). For example, a large-scale study reported that a self-reported stroke measure showed a positive predictive value of 79%, an estimated sensitivity of 80%, and specificity of over 99% (Engstad et al., 2000). Furthermore, a previous study using HRS data confirmed that self-reported stroke is suitable for studying stroke and stroke risk factors (Glymour & Avendano, 2009).

Purpose in Life

Purpose was assessed using a seven item questionnaire adapted from the Psychological Well-Being Scales, a measure with evidence of reliability and vailidity in a nationally representative sample of adults (N=1,108) over the age of 25 (Ryff & Keyes, 1995). Although the original scale includes 20 items, several shortened versions of the scale, ranging from 3 to 14 questions, have been developed and psychometrically assessed (Abbott et al., 2006). A slightly altered version of the 7-item scale that was used in this study, has been psychometrically evaluated and validated in a previous large-scale study(Abbott et al., 2006). On a six-point Likert scale, respondents rated the degree to which they endorsed the following items: "I enjoy making plans for the future and working to make them a reality," "My daily activities often seem trivial and unimportant to me," "I am an active person in carrying out the plans I set for myself," "I

don't have a good sense of what it is I'm trying to accomplish in life," "I sometimes feel as if I've done all there is to do in my life," "I live life one day at a time and don't really think about the future," and "I have a sense of direction and purpose in my life." Negatively worded items were reverse scored. The seven items were averaged (all items were summed together, then divided by seven) to create a scale that ranged from 1 to 6. Higher scores reflected greater levels of purpose (Cronbach $\alpha = 0.73$). The purpose in life scores were then standardized (M=0, SD =1), so that the outcome odds ratio could be interpreted as the result of one standard deviation increase in purpose.

Covariates Measurement

Potential confounds of the association between purpose and stroke included sociodemographic, behavioral, biological, and psychosocial factors relevant to stroke risk. All covariate data were collected at baseline in 2006.

Sociodemographic variables included self-reported age, gender, race/ethnicity (Caucasian-American, African-American, Hispanic, Other) which was dummy coded with Caucasian-American as the reference group, marital status (married/not married), educational attainment **(**no degree, GED or high school diploma, college degree or higher) total wealth (<25,000; 25,000-124,999; 125,000-299,999; 300,000-649,999; >650,000—based on quintiles of the score distribution in this sample), and functional status (difficulties with activities of daily living: bathing, eating, dressing, walking across a room, getting in or out of bed). Functional status was reverse coded so that a higher score indicated higher functioning.

Behavioral covariates included smoking status (never, former, current), frequency of physical activity (never, low: 1-4 per month, moderate: more than once a week, high: daily), and alcohol use (yes/no).

Biological covariates included body mass index (BMI = weight/height^2; <18.5 (underweight), 18.5-24.9 (normal), 25–29.9 (overweight), ≥30 (obese)), systolic and diastolic blood pressure (average of three measurements on the sitting respondent's left arm, 45 seconds apart), hypertension, diabetes, and heart disease (yes/no based on self-report of a doctor's diagnosis). The "underweight" category of BMI was collapsed with the "normal" BMI category because the underweight category contained only 1.37% of the sample and was unstable in statistical analyses.

Psychological covariates included both negative (depression, anxiety, cynical hostility, and negative affect) and positive (optimism**,** positive affect, social participation) factors. Either the exact same scales or slightly modified versions of widely used scales were employed to assess all of the psychological factors in this study. All of the psychological measures used in this study have been rigorously assessed and validated. They have also been used in previous studies. Anxiety was measured using the Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, n.d.; Wetherell & Areán, 1997); cynical hostility was measured using the cynicism subscale of the Cook-Medley Hostility Inventory (Cook & Medley, 1954; Costa, Zonderman, McCrae, & Williams, 1986); depression was measured using the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977); optimism was measured using the Life Orientation Test – Revised (Scheier, Carver, & Bridges, 1994); details about the positive and negative affect scale can be found in Mroczek and Kolarz (1998, p. 1337); the scale used to assess social participation was developed for use in the English Longitudinal Study of Aging—a nationally representative sister study of HRS.

Further information about the psychological measures can be found in the HRS Psychosocial Manual (Clarke, Fisher, House, Smith, & Weir, 2008). We present all means, standard deviations, and internal reliabilities of psychological measures in Table 2.2.

Statistical Analysis

We conducted logistic regression to test whether purpose was associated with stroke. Appropriate information was not available to conduct survival analysis. In order to address the large number of potential covariates and avoid over-fitting the logistic regression models, we examined the impact of the risk factors by creating a core model (Model 2) and then considered the impact of related covariates in turn (Van Belle, 2008). A total of seven models were created. Model 1 adjusted only for age and gender. Model 2, the core model, included: age, gender, race/ethnicity, marital status, educational degree, total wealth, and functional status. Five more models were created: Model 3 – core model + health behaviors (smoking status, exercise, alcohol use), and Model 4 – core model + biological factors (hypertension, diabetes, systolic blood pressure, diastolic blood pressure, BMI, heart disease). Secondary analyses were performed to examine if the effect of purpose was confounded by other psychosocial factors. To test this possibility, we created Models 5 and 6: Model 5 – core model + negative psychological factors (depression, anxiety, cynical hostility, negative affect), and Model 6 – core model + positive psychosocial factors (optimism, positive affect, social participation). We considered the correlations among all psychological predictor variables within the six models—they raised no concerns about multicollinearity. Although doing so could overfit the model and raise multicollinearity issues, we also created a model 7, which included all 23 covariates.

Logits were converted into odds ratios (O.R.) for ease of interpretation. Given that the probability of stroke was rare in our sample (3.93%), our reported odds ratios can be regarded as

relative risk, a more intuitive interpretation for most readers (Van Belle, 2008). We weighted all models using HRS sampling weights to account for the complex multistage probability survey design, which includes individual non-response, sample clustering, stratification, and further post-stratification using Stata (StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP).

Missing Data Analysis

For all study variables, the overall item non-response rate was 1.85%. However, the missing data were distributed across variables, resulting in a 22.39% loss of respondents from our analyses. Therefore, to examine the impact of missing data on our results and to obtain less biased estimates, we used a Markov Chain Monte Carlo multiple imputation technique and reran all analyses. Estimates of regression models were multiple imputation estimates derived using the combining rules defined by Little and Rubin (Little & Rubin, 2002). Where appropriate, design-based analyses of subpopulations—all eligible respondents—were applied to each of the 10 imputed data sets. The multiple imputation multivariate normal command in the Stata package was used. A missing at random mechanism for the missing values was assumed, and accordingly an inclusive as opposed to restrictive use of auxiliary items for each variable with missing data was used (Collins, Schafer, & Kam, 2001; Little & Rubin, 2002).

Results were largely the same between the original and imputed datasets. In all models, purpose was significantly associated with reduced stroke whether the original dataset or imputed dataset was used. We therefore used the dataset with multiple imputation for all analyses reported here because this technique provides a more accurate estimate of association than other methods of handling missing data (Collins et al., 2001; Little & Rubin, 2002)..

Results

Purpose in Life and Stroke Incidence

Among the 6,739 participants, 265 respondents had a stroke over the four-year follow-up. In the core model, which adjusted for age, gender, race/ethnicity, marital status, education, total wealth, and functional status (Model 2), each standard deviation increase in purpose was associated with a multivariate-adjusted odds ratio of 0.78 for stroke (95% CI, 0.67-0.91, p =. 002), meaning that individuals with higher purpose were at lower risk for a stroke. We also considered the possibility of threshold effects by initially creating tertiles (low, moderate, high) and quartiles, but no threshold effect was detected. Therefore, we continued treating purpose as a continuous variable in all our reported analyses. The association between purpose and stroke remained significant in all the models. Interactions between the sociodemographic variables and purpose were examined. The interactions between the medical conditions and purpose were also examined. No interactions were significant, suggesting that the association between purpose and stroke did not vary by any of the variables examined.[1]

Psychological Covariates

We conducted secondary analyses to examine if associations found between purpose and stroke were primarily attributable to the absence of negative psychological factors. We created a base model including age, gender, race/ethnicity, marital status, education, total wealth, functional status, and one negative psychological factor (anxiety, cynical hostility, depression, and negative affect). The correlations between purpose and the negative psychological factors

[1] To examine what the "active ingredients" might be that are driving the association between purpose in life and stroke, we examined each item of the Ryff purpose in life scale in relation to stroke. Each model used logistic regression and adjusted for demographic factors. Results can be found in Table 2.4.

were -0.33 (anxiety), -0.25 (cynical hostility), -0.34 (depression), and -0.45 (negative affect). We tested whether each of the negative psychological factors was independently associated with stroke. Analyses indicated that anxiety (O.R. = 1.40, 95% CI, 1.08-1.81, p = .013), depression (O.R. = 1.16, 95% CI, 1.10-1.24, p <.001) and negative affect (O.R. = 1.39, 95% CI, 1.16-1.68, p = .001) were significantly associated with stroke, whereas cynical hostility was not (p= .457). Each negative psychological factor, when entered into the base model caused only a modest decrease in the association between purpose and stroke. We then simultaneously examined the impact of all four negative psychological factors within the base model (Model 5, Table 2.3). The effects of purpose remained significant in all models, implying that purpose displays a protective effect against stroke above and beyond the effects of the negative psychological states and traits tested.

To examine if the correlation between purpose and stroke reflected the operation of other positive psychosocial factors (optimism, positive affect, social participation), we ran the same procedure described above. The correlations between purpose and the positive psychosocial constructs were 0.35 (optimism), 0.43 (positive affect), and 0.26 (social participation). When we examined if the positive psychosocial variables were independently associated with stroke, analyses indicated that optimism (O.R. = 0.87, 95% CI, 0.77-0.99, *p* = .044) and social participation (O.R. = 0.78, 95% CI, 0.70-0.86, *p* <.001) were significantly associated with stroke, whereas positive affect was not (*p* = .168). When added separately as covariates, optimism, positive affect, and social participation led to only a modest decrease in the association between purpose and stroke. When all the positive psychosocial factors were added simultaneously (Model 6, Table 2.3), the association between purpose and stroke remained significant, implying

that purpose displays a protective effect against stroke above and beyond the effects of the positive psychosocial factors tested.

Discussion

Purpose in life was associated with a reduced incidence of stroke in a prospective and nationally representative sample of older American adults who were stroke-free at baseline. After adjusting for several covariates, each standard deviation increase in purpose was associated with a 22% reduced risk of stroke over a four-year follow-up. The association between purpose and stroke held even after adjusting for potential sociodemographic, behavioral, biological, and psychosocial factors. Furthermore, because many of the covariates may serve as mechanisms by which purpose is linked to stroke, estimates from the multivariate models may underestimate the association.

Past research regularly cites negative states and traits as risk factors for stroke. However, purpose showed a protective effect above and beyond what negative psychological states and traits (e.g. anxiety, cynical hostility, depression, and negative affect) could predict. These results demonstrate that the lower risk attributable to purpose is not caused by the absence of negative states and traits. This finding adds to the literature that has begun teasing apart how the biological benefits originating from positive well-being are distinct from the physiological costs attributable to negative psychological factors (Pressman & Cohen, 2005; Ryff, Singer, & Love, 2004; Seligman, 2008). We also examined if purpose was associated with reduced stroke incidence because it was a mere correlate of other positive psychosocial constructs that have been linked with enhanced physical health (optimism, positive affect, social participation).

Again, purpose was associated with a reduced risk of stroke even after adjusting for these positive factors.

Although the mechanisms responsible for purpose's health-promoting effects are yet unknown, studies have linked purpose with various biological processes. Purpose, for example, may promote health by regulating immune system functioning. Among bereaved women participating in a distress-alleviating intervention, those showing greater increases in purpose displayed the steepest increases in natural killer cell activity – an indication of optimal immune system functioning (Bower, Kemeny, Taylor, & Fahey, 2003). A recent study found that elderly women with greater levels of purpose exhibited lower levels of sIL-6r, an inflammatory marker implicated in age-related disorders such as stroke, cardiovascular disease, rheumatoid arthritis, and Alzheimer's disease (Friedman, Hayney, Love, Singer, & Ryff, 2007). Greater purpose has also been associated with a range of other biological markers including lower levels of salivary cortisol, a lower waist-hip ratio, higher levels of HDL ("good" cholesterol), and healthier telomerase activity (Bower et al., 2003; Jacobs et al., 2011; Lindfors & Lundberg, 2002; Ryff et al., 2004). These findings suggest that the benefits of purpose broadly impact the body's physiological systems.

The present study has several limitations. The current study may be limited in that the stroke outcome measure was based on self-report. Although previous studies report a high correlation between self-reported stroke and hospital records, discrepancies exist. Therefore, assessing stroke using self or proxy report may have biased our study's results. A review of the literature suggests that a non-differential misclassification of self-reported stroke exists. Depending on several factors, this potential bias may have caused the association between purpose and stroke to be underestimated or overestimated (Jurek, Greenland, Maldonado, &

Church, 2005). The potential factors that can underestimate or overestimate the association between purpose and stroke should be examined in future research (Jurek et al., 2005). Self-report of doctor's diagnosis or proxy reports for deceased respondents, however, have been shown to highly correspond with medical records (Bergmann et al., 1998; Bots et al., 1996; Engstad et al., 2000; Glymour & Avendano, 2009; Okura et al., 2004), one of which, specifically examined HRS—the dataset we used in this study (Glymour & Avendano, 2009).

Another limitation is that some risk factors, such as family history of cardiovascular or cerebrovascular disease, genetic vulnerability, and cognitive functioning were not available for analysis. The lack of these variables may have adversely impacted our findings. For example, an individual with dementia could have skewed the self-reported data. Caution is required when interpreting the current results. Stroke may occur as a result of long-term unhealthy lifestyle choices and the accumulation of physiological changes. It is conceivable that purpose may be a marker rather than a cause of increased stroke risk. Lastly, HRS includes couples in the dataset. Therefore, future studies should consider using dyadic analyses to account for the potential correlation in purpose scores between couples.

Our study was unique, however, because it examined a variety of potential confounding factors such as the presence of other positive psychological constructs and the absence of negative psychological constructs, along with potential demographic, behavioral and biological risk factors. Adjustment for this wide range of covariates does not rule out, but tempers the possibility of reverse causation.

Given that serious diseases increase with age, the discovery of potentially modifiable factors that protect against ill health is vital to the rapidly expanding segment of older Americans. Nationally representative longitudinal studies and a meta-analysis of 70 publications

have shown that purpose declines with age (Pinquart, 2002). If further studies find that purpose is associated with enhanced health outcomes, researchers should begin exploring possible interventions that target purpose in life. While no such interventions currently exist for this particular cause, well-designed studies have shown that techniques such as Well-Being Therapy, Loving-Kindness Meditation, and other meditation techniques can increase purpose in life (Fava & Tomba, 2009; Jacobs et al., 2011; Johnson et al., 2009). If future studies replicate the results from this study, it is sensible to develop and test interventions that enhance purpose and examine if these purpose-raising interventions can protect against stroke (Peterson & Kim, 2011).

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Table 2.1. Distribution statistics of covariates

Measure	Mean/%	SD	Range
Age	68.78	9.84	53-105
Female	58.45%		
Married Status	64.93%		
Race/Ethnicity			
Caucasian	78.26%		
African-American	12.76%		
Hispanic	7.60%		
Other	1.38%		
Education			
< High School	18.56%		
High School	55.03%		
≥ College	26.41%		
Total Wealth			
1st Quintile	16.07%		
2nd Quintile	18.78%		
3rd Quintile	21.64%		
4th Quintile	21.47%		
5th Quintile	22.04%		
Functional Status	5.75	0.75	1-5
Smoking Status			
Never	44.43%		
Former Smoker	43.14%		
Current Smoker	12.43%		
Exercise			
Never	62.24%		
Low	14.46%		
Moderate	20.63%		
High	2.67%		
Drink Alcohol	51.85%		
Hypertension	54.83%		
Diabetes	18.45%		
Systolic BP, mm HG	133.32	21.60	72-224
Diastolic BP, mm HG	80.37	12.50	42-155
BMI, kg/m^2			
≤ 24.99	29.87%		
25-29.99	38.43%		
≥ 30	31.70%		
Heart Disease	21.99%		

Table 2.2. Descriptive statistics and reliabilities for psychological factors

	Mean (SD)	Range	α
Purpose in Life	4.54 (0.92)	1 – 6	0.73
Anxiety	1.56 (0.56)	1 – 4	0.80
Cynical Hostility	4.61 (1.00)	1 – 6	0.79
Depression	1.38 (1.90)	0 – 8	0.88
Negative Affect	1.62 (0.65)	1 – 5	0.86
Optimism	4.55 (1.15)	1 – 6	0.79
Positive Affect	3.59 (0.68)	1 – 5	0.91
Social Participation	4.34 (1.81)	1 – 8	0.65

Table 2.3. Odds ratios for the association between purpose in life and stroke

Model	Covariates	Purpose-adjusted logistic regression (95% CI)	P-value
1	Age + gender	0.75 (0.65-0.86)	<0.001
2	Demographic*	0.78 (0.67-0.91)	0.002
3	Demographic* + Health behaviors[†]	0.82 (0.71-0.95)	0.010
4	Demographic* + Biological factors[‡]	0.81 (0.69-0.94)	0.007
5	Demographic* + Negative psych factors[§]	0.82 (0.70-0.95)	0.010
6	Demographic* + Positive psych factors[‖]	0.82 (0.70-0.94)	0.007
7	All covariates[¶]	0.86 (0.74-1.00)	0.049

*Demographic factors: age, gender, race/ethnicity, marital status, education level, total wealth, functional status

[†]Health behaviors: smoking, exercise, alcohol use

[‡]Biological factors: hypertension, diabetes, systolic blood pressure, diastolic blood pressure, BMI, heart disease

[§]Negative psychological factors: depression, anxiety, cynical hostility, negative affect

[‖]Positive psychosocial factors: optimism, positive affect, social participation

[¶]All covariates: age, gender, race/ethnicity, marital status, education level, total wealth, functional status, smoking, exercise, alcohol use, hypertension, diabetes, systolic blood pressure, diastolic blood pressure, BMI, heart disease, depression, anxiety, cynical hostility, negative affect, optimism, positive affect, social participation

Table 2.4. Odds ratios for the association between each item of the Ryff purpose in life scale and stroke (adjusting for demographic factors)*

Wording of item	Adjusted OR (95% CI)	P-value
I enjoy making plans for the future and working to make them a reality	0.98 (0.85-0.98)	0.016
My daily activities often seem trivial and unimportant to me	0.93 (0.87-1.00)	0.048
I am an active person in carrying out the plans I set for myself	0.91 (0.84-0.98)	0.010
I don't have a good sense of what it is I'm trying to accomplish in life	0.97 (0.91-1.03)	0.383
I sometimes feel as if I've done all there is to do in life	0.95 (0.89-1.02)	0.165
I live life one day at a time and don’t really think about the future	0.94 (0.89-1.00)	0.061
I have a sense of direction and purpose in my life	0.92 (0.85-0.99)	0.021

*All models adjusted for age, gender, race/ethnicity, marital status, educational attainment, and total wealth

CHAPTER III

Purpose in life and reduced risk of myocardial infarction among older US adults with coronary heart disease: A two-year follow-up

This chapter is adapted from my original paper "Purpose in life and reduced risk of myocardial infarction among older U.S. adults with coronary heart disease: A two-year follow-up." (Kim, Sun, Kubzansky, Park, & Peterson, 2013).

Introduction

Coronary heart disease is the leading cause of death among both men and women in the United States–responsible for one in every six deaths (Heron et al., 2009). It imposes immense physical, psychological, social, and financial burden on individuals, families, and society as a whole. Ongoing research efforts have focused on identifying the risk and protective factors that prevent coronary heart disease and promote heart health.

Past research has mostly looked at the impact of negative psychological states or traits (e.g., depression, anxiety, and cynical hostility) on health outcomes such as myocardial infarction (Kubzansky & Kawachi, 2000; Rozanski et al., 2005; Whooley et al., 2008; Wulsin & Singal, 2003). More recently, an increasing number of researchers have investigated how positive psychological characteristics such as optimism and positive emotions protect against illness and promote health and longevity (Chida & Steptoe, 2008; Pressman & Cohen, 2005; Peterson, Seligman, & Vaillant, 1988; Seligman, 2008; Steptoe et al., 2009; Xu & Roberts,

2010). The identification of positive psychological constructs that protect against illness is particularly important for the rapidly expanding segment of older American adults facing the dual threat of declining health and skyrocketing health care costs.

Purpose in life is among the positive constructs that contemporary psychologists have studied because of its potential to predict and promote better health (Boyle et al., 2009; Frankl, 2006; Maslow, 1962; Peterson, 2006; Ryff & Keyes, 1995). The definition of purpose in life varies throughout the field, but it is usually conceptualized as an individual's sense of directedness and sense of meaning in his or her life (Steger et al, 2006). The terms "purpose in life" and "meaning in life" are often used interchangeably in the literature.

Recently, purpose in life has been studied as an important determinant of health outcomes, specifically, mental health and age–related physical health outcomes. Greater purpose has been associated with reduced risk of Alzheimer's disease (Boyle et al., 2010) and increased longevity in both American and Japanese samples (Boyle et al., 2009; Sone et al., 2008). However, prospective studies examining the association between purpose in life and cardiovascular disease are lacking, although existing studies are suggestive. In a cross-sectional study of a Hungarian sample, purpose in life was associated with good female cardiovascular health (Skrabski et al, 2005). In a Japanese sample, purpose in life was related to reduced cardiovascular disease mortality in a 7-year follow-up (Sone et al., 2008). More controlled longitudinal research studies are needed to understand the relationship between life purpose and cardiovascular health.

Research has suggested that purpose fosters well-being by positively impacting biological, psychological, and behavioral pathways (e.g., Alim et al., 2008; Friedman et al., 2007; Steptoe et al., 2008; Wood & Joseph, 2009). A number of studies have examined the

biological (e.g., existing health problems), psychosocial (e.g., depression, anxiety, hostility, social isolation, optimism, positive emotion), and behavioral (e.g., smoking, drinking, exercise) risk and protective factors that influence the risk of experiencing a primary coronary event (Eagle et al., 2010; Peterson & Kim, 2011; Rozanski et al., 2005). However, very few studies have investigated the association between positive psychological factors and cardiovascular outcomes, such as myocardial infarction, among high-risk populations after the initial cardiac incident.

The risk of myocardial infarction is five to seven times higher for patients with coronary heart disease compared to those without overt coronary symptoms (Rossouw, Lewis, & Rifkind, 1990). Although first coronary events result in serious health outcomes, they are usually not fatal. Individuals with coronary heart disease, however, are at higher risk of reinfarction and mortality, thus require more intensive treatment and monitoring. The risk for secondary coronary events and mortality is significantly higher within the first few years following the initial cardiac event (Udvarhelyi et al., 1992). In order to develop comprehensive ways of preventing and mitigating coronary events, it is important to understand resilience factors that help prevent against secondary coronary events such as myocardial infarction. Our study addresses this important research gap.

The present study used secondary analyses of archival data from the Health and Retirement study, a prospective study of a large and nationally representative sample of US adults. The aim of the present study was to examine the relationship between purpose in life and myocardial infarction in older adults with coronary heart disease over a two-year period. In order to examine the potential impact of covariates, we adjusted for sociodemographic, behavioral, biological, and psychological factors. We hypothesized that higher purpose in life would be

associated with lower risk of myocardial infarction among older adults with coronary heart disease, even after adjusting for potential confounds.

In light of studies linking positive psychological constructs (optimism and positive affect) with better health outcomes (Kim, Park, & Peterson, 2011; Pressman & Cohen, 2005; Rasmussen et al., 2009), we evaluated whether any observed effects between purpose and reduced myocardial infarction reflected purpose's potential overlap with these other positive psychological constructs. In addition, to address possible concerns that associations between purpose and myocardial infarction might reflect the absence of negative psychological factors, we used anxiety, cynical hostility, and depression as covariates. Additional covariates included behavioral and biological factors that might influence the risk of myocardial infarction. To address the possibility that the measure of purpose reflected perceived health, which predicts illness and longevity over and above objective health measures (Idler & Benyamini, 1997), we controlled for self-reported health. Similarly, coronary heart disease severity was controlled to ensure that levels of purpose did not reflect coronary heart disease severity.

Method

Study Population

The Health and Retirement Study (HRS) is a nationally representative panel study that surveys more than 22,000 Americans aged 50 and older every two years. HRS was launched in 1992 to characterize an aging America's physical and mental health, health insurance coverage, health care use, family composition, and living arrangements. The study was designed to inform major policies affecting retirement, health insurance, and economic well-being of the aging population. In 2006, HRS began collecting psychosocial measures. Therefore, we report data

from respondents in the eighth (2006) and ninth waves (2008) along with exit interviews. For respondents who had died, exit interviews were completed by knowledgeable informants. Ninety-one individuals were excluded because they did not complete follow-up surveys, and 178 were excluded because of incomplete data on one or more measures. The final sample used for analysis included 1,546 respondents (788 women and 756 men). The mean age of study respondents at baseline was 72.16 years (SD, 9.42; range, 53 to 101 years). Study participants did not differ from the excluded group in coronary heart disease severity, gender ratio, alcohol use, body mass index, diastolic blood pressure, or systolic blood pressure. Study participants, however, were younger, less ethnically diverse, more educated, more likely to be married, and less likely to smoke. Demographic characteristics of the participants are presented in Table 3.1.

Procedure

In 2006, approximately 50% of HRS respondents were visited for a face-to-face interview. At the time of the interview, respondents received a self-report psychosocial questionnaire that they completed and mailed to the University of Michigan. The response rate was 90% (*N*= 7,732). Among these participants, 1,815 were eligible at baseline for our study due to their previous diagnosis of coronary heart disease (heart attack, coronary heart disease, angina, or congestive heart failure). Coronary heart disease diagnosis was determined by self-report of a physician's diagnosis. The validity of using self-report as an accurate estimate of coronary heart disease diagnosis has been shown. Self-report of a physician's diagnosis of heart disease has shown substantial agreement with medical-record reports (Bergmann et al., 1998; Lampe et al., 1999; Psaty et al., 1995; Voaklander et al., 2006). The University of Michigan's Institute for Social Research is responsible for the study and provides extensive documentation of the

protocol, instrumentation, sampling strategy, and statistical weighting procedures (Wallace & Herzog, 1995).

Measures

Self-reported health measures used in HRS have been rigorously assessed (Wallace & Herzog, 1995) and have shown substantial agreement with medical record reports (Bush et al., Golden & Hale, 1989).

Myocardial Infarction

We used survey data from 2008 and exit interviews to assess both fatal and non-fatal cases of myocardial infarction in the sample of individuals with heart disease. Occurrence of myocardial infarction was assessed based on the respondent's answer to the question "Since [last interview date] has a doctor told you that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?" [If so] "Did you have a heart attack or myocardial infarction?" The respondent then provided the year of the myocardial infarction. All myocardial infarctions occurring after the baseline interview were coded as a myocardial infarction. This method of health assessment has been used previously with the HRS data, and previous studies have shown high agreement between self-report questionnaires and medical record diagnosis of myocardial infarction (Banks et al., 2006; Bush et al., 1989; Cigolle et al., 2007; McWilliams et al., 2007; McWilliams et al., 2003; Okura et al., 2004).

Coronary Heart Disease Severity

Because objective measures of coronary heart disease severity were not available, a proxy index of coronary heart disease severity was constructed by summing seven indicators (range 0-7). The index was based on the following self-reported data: (a) heart medication use (no=0, yes=1); (b) the presence of physiological risk factors (doctor diagnosis of high blood

pressure, high cholesterol, diabetes) (no = 0, yes = 1; total range 0-3), and (c) the presence of coronary heart disease-related complications (hospitalization due to heart failure, heart treatment, heart surgery) (no = 0, yes = 1; total range 0-3). This index was derived from the coronary heart disease severity measure used by Aalto et al. (2005).

Purpose in Life

Purpose was assessed using a 7-item questionnaire adapted from Ryff's Psychological Well-Being Scale, a scale with evidence of reliability and vailidity in a nationally representative sample of adults (N=1,108) over the age of 25 (Ryff & Keyes, 1995). Although the original scale includes 20 items, several shortened versions of the scale, ranging from 3 to 14 questions, have been developed and psychometrically assessed (Abbott et al., 2006; Ryff, 1989). On a six-point Likert scale, respondents were asked to rate the degree to which they endorsed such items as "I am an active person in carrying out the plans I set for myself" and "I don't have a good sense of what it is I'm trying to accomplish in life." Negatively-worded items were reverse scored, and all seven items were averaged. Higher scores reflected higher levels of purpose. Cronbach's coefficient α was 0.74.

Covariates

Potential confounds of the association between purpose and myocardial infarction included coronary heart disease severity, self-rated health, sociodemographic, behavioral, biological, and psychological factors relevant to myocardial infarction. All covariates were measured at baseline in 2006.

Following McWilliams et al. (2007), we used HRS data to create a measure of self-rated health that approximates the scales found in Short Form-36. Our measure of self-rated health encompassed five broad domains of health: general health status, change in general health,

mobility, agility, and pain. Although McWilliams et al. also included a depression scale, we excluded depression from our self-rated health measure because it is included in our secondary analyses as a psychological covariate.

Sociodemographic variables included self-reported age, gender, race/ethnicity (Caucasian-American, African-American, Hispanic, Other; dummy coded with Caucasian-American as the reference group), educational attainment (no degree, GED or high school diploma, college degree or higher), and marital status (married, not married)**.**

Behavioral covariates included smoking status (current smoker: yes/no), frequency of physical activity (low: never to once a week and high: more than once a week or every day), and and alcohol consumption (yes/no).

Biological covariates included body mass index (BMI = weight/height^2; <18.5 (underweight), 18.5-24.9 (normal), 25–29.9 (overweight), ≥30 (obese); the underweight group had only 17 individuals, therefore the group was eliminated and the individuals from the underweight group were combined with the normal weight group) and, systolic and diastolic blood pressure (average of three measurements on the sitting respondents left arm, 45 seconds apart).

Psychological covariates included optimism ($\alpha = 0.80$), positive affect ($\alpha = 0.89$), anxiety ($\alpha = 0.81$), cynical hostility ($\alpha = 0.80$), and depression ($\alpha = 0.89$). Further information about the psychological measures can be found in the HRS Psychosocial manual (Clarke et al., 2008).

Statistical Analyses

We conducted logistic regression to test whether purpose was associated with risk of myocardial infarction. Preparation for statistical analyses was performed in four steps. First, we examined the statistical assumptions required for logistic regression. Among other checks, we

examined frequency distributions for all continuous variables and found that normalization was not necessary. Second, we reviewed the literature and selected various risk factors for myocardial infarction for inclusion as covariates. Third, we considered the correlations among all psychological predictors–to see if there were concerns about multicollinearity issues. Some of the psychological variables were too highly correlated with one another and would cause multicollinearity problems if they were all entered simultaneously. Therefore, the positive and negative psychological covariates were analyzed separately. Fourth, to address the possibility that levels of purpose simply reflected coronary heart disease severity, we adjusted for coronary heart disease severity in all analyses.

According to Bagley et al. (2001), simulation experiments suggest that for logistic regression, approximately 10 outcomes (e.g., myocardial infarctions) should exist for each predictor variable, in order to avoid overfitting the model. We determined that any model with more than eight predictor variables would overfit the logistic models in this sample. Therefore, we examined the impact of the risk factors by creating a core model and considered the impact of groups of related covariates in turn – no model contained more than eight predictors. Model 1 – core model (purpose, age, gender, coronary heart disease severity, self-rated health); Model 2 – core model + additional sociodemographics (race/ethnicity, educational degree, marital status); Model 3 – core model + health behaviors (current smoker, exercise, alcohol use); Model 4 – core model + biological factors (body mass index, systolic/diastolic blood pressure. Secondary analyses were performed to examine if the effects of purpose were confounded by other psychological constructs. To test this possibility, we created Model 5 – core model + each psychological covariate separately and groups of positive and negative psychological covariates simultaneously.

Logits were converted into odds ratios (O.R.) for ease of interpretation. Because probability of myocardial infarction was rare in our sample (4.9%), our reported odds ratios can roughly be interpreted as relative risk, which presents a more intuitive interpretation for most readers (Van Belle, 2008). All models were weighted using HRS sampling weights to account for the complex multistage probability survey design, which includes individual non-response, sample clustering, stratification, and further post-stratification using Stata (StataCorp. 2010. *Stata Statistical Software: Release 11*. College Station, TX: StataCorp LP).

Missing Data Analysis

To examine the impact of missing data on our results, we used the Imputation by Chained Equations technique as well as the Markov Chain Monte Carlo method and reran all analyses. (Enders, 2006; Greenland & Finkle, 1995; Little & Rubin, 2002; Royston, 2009). We then compared the results using the original dataset to the results from the dataset with multiple imputations. Results were essentially the same between the two data sets, suggesting that missing data had minimal impact on our conclusions. We therefore used the original dataset for our final analyses.

Results

Purpose in Life and Myocardial Infarction

Among the 1,546 participants, 76 had a myocardial infarction over the two-year follow-up. After controlling for age, gender, coronary heart disease severity, and self-rated health (Model 1), each unit increase in purpose had a multivariate adjusted odds ratio (O.R.) of 0.73 for myocardial infarction (95% CI, 0.57-0.93, $p = 0.01$). In other words, each unit increase in purpose was associated with a 27% reduction in odds of a myocardial infarction. The association

between purpose and myocardial infarction remained significant in all five models regardless of which covariates were included (Table 3.2)

Although doing so would overfit the model, we considered simultaneously entering all the covariates in the model to examine the outcome. However, as explained previously, the psychological variables would be too highly correlated with one another and cause multicollinearity problems if they were all entered simultaneously. Therefore, we tried including all 13 non-psychological covariates in a model, which resulted in a multivariate-adjusted O.R. of 0.75 for purpose and myocardial infarction (95% CI, 0.56-1.03, $p = 0.07$).

We did not detect any interaction effects of age, gender, coronary heart disease severity, race/ethnicity, education, or marital status suggesting that the association between purpose and myocardial infarction does not vary by any of the sociodemographic variables.

Psychological Covariates

We conducted secondary analyses to examine if associations found between purpose and myocardial infarction were primarily attributable to the absence of negative psychological factors. We first examined the correlations between purpose and the negative psychological variables (anxiety, cynical hostility, and depression). Correlations were -0.28 (anxiety), -0.22 (cynical hostility), and -0.29 (depression). We then tested whether each of the negative psychological variables were independently associated with myocardial infarction. Analyses indicated that anxiety (O.R. = 1.69, 95% CI, 1.09-2.62, $p = .02$), cynical hostility (O.R. = 1.40, 95% CI, 1.15-1.71, $p < .001$), and depression (O.R. = 1.21, 95% CI, 1.10-1.33, $p < .001$) were significantly associated with myocardial infarction. Next, we separately examined the impact of each negative psychological variable within the base model—model five. Each negative psychological variable caused only a modest decrease in the association between purpose and

myocardial infarction. We then simultaneously added all the negative psychological variables into the model, and purpose remained significant (O.R. = 0.76, 95% CI, 0.58-1.00, p =.046). The effect of purpose remained significant in all models, implying that purpose displays a protective effect against myocardial infarction above and beyond the effects of the negative psychological states and traits tested.

To examine if the correlation between purpose and myocardial infarction reflected the operation of other positive psychological constructs (optimism or positive affect), we ran the same procedure described above with the positive psychological constructs. We examined the correlations between purpose and the positive psychological constructs. Correlations were 0.33 (optimism) and 0.34 (positive affect). We then examined if the positive psychological variables were independently associated with myocardial infarction. Analyses indicated that both optimism (O.R. = 0.62, 95% CI, 0.51-0.76, p <.001) and positive affect (O.R. = 0.68, 95% CI, 0.49-0.95, p =.02) were significantly associated with myocardial infarction. We then separately examined the impact of each positive psychological covariate on the association between purpose and myocardial infarction. Adding optimism or positive affect caused only a modest decrease in the association between purpose and myocardial infarction. We also tried adding both covariates simultaneously. The effect of purpose on myocardial infarction remained evident even after positive affect and optimism were controlled for simultaneously (O.R. = 0.75, 95% CI, 0.62-1.00, p =.048), implying that purpose displays a protective effect against myocardial infarction above and beyond the effects of these other positive psychological constructs.

Discussion

This is among the first studies to investigate the association between purpose—a sense of direction and meaning in one's life—and risk of myocardial infarction among individuals with coronary heart disease. Analyses were conducted using data from a large, prospective, and nationally representative panel study of U.S. adults over the age of 50 with coronary heart disease. Increased purpose was associated with reduced risk of myocardial infarction during a two-year follow-up, implying that purpose is a possible protective factor against near-future myocardial infarction among those with coronary heart disease. As noted by a National Heart Lung and Blood Institute committee, identifying factors that forecast near-future cardiovascular events has important implications for individuals with coronary heart disease because they require especially aggressive treatment and monitoring (Eagle et al., 2010). Hence, our analysis captured an appropriate follow-up period because it evaluated a near-term window of two years, which is usually a period of high recurrence for coronary events. The protective effect of purpose was maintained even after adjusting for a variety of potential confounders including coronary heart disease severity, self-rated health, and sociodemographic, behavioral, biological, and psychological covariates.

Past research has regularly documented negative emotions as risk factors for myocardial infarction. However, purpose showed a protective effect on cardiovascular health above and beyond what negative psychological states and traits (e.g., anxiety, cynical hostility, and depression) could explain. These results suggest that the lower risk of myocardial infarction is attributable to purpose and not to the absence of negative psychological factors. This finding adds to the research that has begun to tease apart and demonstrate how biological benefits

attributable to positive well-being are unique from the physiological costs attributable to negative psychological states and traits (Pressman & Cohen, 2005; Seligman, 2008). Current findings also demonstrated that purpose was not merely reflecting a correlation with other health-relevant positive psychological variables (optimism, positive affect). Analyses showed that purpose was associated with better cardiovascular health above and beyond the effects of optimism and positive affect. Further research is needed to understand the unique effects of purpose in life on cardiovascular health compared to other positive psychological variables.

Although evidence linking purpose and cardiovascular health is accumulating, the underlying mechanisms and processes that enable purpose to promote heart health outcomes are largely unknown. Research suggests that purpose may protect against cardiovascular disease through multiple pathways that are biological, psychological, behavioral, and social in nature. Biologically, purpose has been linked with better immune system functioning (Bower et al., 2003), lower levels of sIL-6r, an inflammatory marker implicated in age-related disorders (Friedman et al., 2007), healthier regulation of cortisol (Lindfors & Lundberg, 2002), and higher levels of high density lipoprotein (the "good" cholesterol) (Ryff et al., 2004). Psychologically, purpose has been linked to a variety of psychological states and traits known to foreshadow good health, such as optimism and positive emotion, freedom from depression, self-efficacy, and problem-focused coping (Skrabski et al, 2005; Wood & Joseph, 2009).

When individuals have a strong sense that their life has meaning, it may increase their will to live, as reflected in heart health-promoting behaviors such as sensible eating, exercise, and fewer health-compromising behaviors such as drinking alcohol in excess and smoking. Purpose in life may also increase adherence to medical regimens. Evidence from previous studies support these possibilities (e.g., Skrabski et al, 2005; Sone et al, 2008). Unknown is whether and

how mechanisms differ as a function of the individual's age, gender or lifestyle. More studies are needed to further understand the mechanisms that may allow purpose to protect against cardiovascular disease.

In the current study, purpose was negatively correlated with age among older adults. This result is consistent with previous findings where purpose in life was lower among older adults compared to middle-aged and younger adults (Ryff & Singer, 1998; Sone et al., 2008). Studies have reported that the risk of reinfarction and cardiovascular mortality increases significantly among older adults (Udvarhelyi et al., 1992). Considering the potentially protective role of purpose on heart health, this finding is troublesome. More research and attention is needed to find ways of enhancing and maintaining purpose, especially among older adults.

Despite mounting research establishing the impact of psychological factors on cardiovascular health, translating empirical findings into practical and effective interventions has been challenging. Several large-scale behavioral intervention trials aimed at reducing cardiovascular events in cardiac patients have yielded mixed results (Rozanski et al., 2005; Peterson & Kim, 2011). These interventions, however, focused on reducing the effects of heightened negative psychological states and traits. Given the results of our study and the growing research demonstrating that positive psychological functioning uniquely contributes to cardiovascular health, more research on interventions that increase positive functioning is warranted (Giltay et al., 2006; Kim, Park, & Peterson, 2011; Kubzansky et al., 2004; Kubzansky & Thurston, 2007; Scheier et al., 1999; Tindle et al., 2009).

Although the sample was nationally representative, the present study is limited to U.S. adults over the age of 50 and may not be generalizable to different groups. Hence, the associations investigated in this study should be explored in younger cohorts. A further limitation

of our study was that data on some risk factors were not available for analysis including family history of cardiovascular disease. Additionally, verification of myocardial infarction, coronary heart disease, or coronary heart disease severity with medical records was not possible. However, self-report of doctor's diagnosis provides an accurate estimate of cardiovascular outcomes, including myocardial infarction and coronary heart disease (Bush et al., 1989; Glymour & Avendano, 2009; Heckbert et al., 2004; Ives et al., 1995; Okura et al., 2004). Finally, our study was limited because a standardized coronary heart disease severity measure was not available. Hence, future investigations should further explore the associations from this study with a more standardized scale. A commonly discussed tradeoff in large-scale studies is one between breadth versus depth of measurements. Our study was unique, however, in that it had the capacity to test a wide range of covariates.

In sum, the current findings are largely consistent with previous studies showing a positive relationship between purpose in life and good cardiovascular health (Sone et al, 2008; Skrabski et al, 2005). However, the present study adds new evidence that purpose in life could be a protective factor against myocardial infarction among high risk groups with coronary heart disease. However, before we use the study results to develop any interventions to increase heart health, there are issues that need to be addressed as this work continues. Although purpose among people without coronary heart disease at baseline was higher compared to those with coronary heart disease, the level of purpose varied among those with coronary heart disease. In fact, there were people who had coronary heart disease despite a high level of purpose, suggesting a complex relationship between purpose in life and cardiovascular health. Future studies need to address how purpose in life plays a role across the lifespan and across different stages of heart health, including onset of the disease, short-and long-term progression of the

disease, recovery, and health maintenance. Is there a critical level of purpose, and how does it interact with other factors to produce a maximum benefit for cardiovascular health?

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Table 3.1.Descriptive statistics for all covariates

Risk Factor	Mean/Count	Percent	SD (Range)
Purpose in Life	4.38		0.93 (1-6)
Mean Age	72.16		9.42 (53-101)
Female	788	50.97%	
CHD Severity	2.64		1.37 (0-7)
Self-Rated Health	21.06		5.59 (0-22)
Race/Ethnicity			
Caucasian	1274	82.41%	
African-American	177	11.45%	
Hispanic	73	4.72%	
Other	22	1.42%	
Education			
< High School	315	20.38%	
High School	872	56.40%	
≥ College	359	23.22%	
Married	984	63.65%	
Smoking			
Current Smoker	177	11.45%	
Exercise			
Low	1396	90.30%	
High	150	9.70%	
Alcohol Use	739	47.80%	
BMI			
18.5-24.9	447	28.91%	
25-29.9	587	34.97%	
≥ 30	512	33.12%	
Systolic Blood Pressure	136.29		22.18 (80-224)
Diastolic Blood Pressure	80.18		12.69 (45-140)
Positive Psychological Variables			
Optimism	4.45		1.16 (1-6)
Positive Affect	3.57		0.68 (1-5)
Negative Psychological Variables			
Anxiety	1.64		0.61 (1-4)
Cynical Hostility	3.03		1.16 (1-6)
Depression	1.75		2.10 (1-8)

Table 3.2. Logistic regressions of purpose and myocardial infarction

Factor	Model 1	Model 2	Model 3	Model 4	Model 5[a]	Model 5[b]
Purpose in Life	0.73 (0.57-0.93)*	0.74 (0.57-0.97)*	0.76 (0.58-0.97)*	0.71 (0.52-0.97)*	0.75 (0.62-1.00)*	0.76 (0.58-1.00)*
Age	0.89 (0.69-1.16)	0.85 (0.66-1.10)	0.93 (0.72-1.23)	0.94 (0.72-1.21)	0.91 (0.68-1.20)	0.93 (0.70-1.24)
Female	0.60 (0.34-1.04)	0.46 (0.24-0.86)*	0.62 (0.38-1.03)	0.45 (0.26-0.78)*	0.61 (0.35-1.06)	0.66 (0.37-1.16)
CHD Severity	1.29 (1.02-1.63)*	1.29 (1.01-1.64)*	1.31 (1.04-1.66)*	1.38 (1.09-1.76)*	1.27 (0.99-1.61)	1.30 (1.02-1.66)*
Self-Rated Health	0.94 (0.89-0.99)*	0.96 (0.91-1.01)	0.94 (0.90-0.00)*	0.93 (0.89-0.98)*	0.94 (0.88-0.99)*	0.95 (0.89-1.03)
Race/Ethnicity						
Caucasian		1.00				
African-American		1.57 (0.68-3.62)				
Hispanic		0.90 (0.25-3.20)				
Other		1.56 (0.38-6.33)				
Education						
< High School		1.00				
High School		0.84 (0.44-1.57)				
≥ College		0.28 (0.09-0.90)*				
Married		0.56 (0.32-0.97)*				
Smoking						
Current			1.52 (0.71-3.26)			
Exercise						
Low			1.00			
High			1.15 (0.68-1.96)			
Alcohol Use						
BMI						
18.5-24.9				1.00		
25-29.9				0.38 (0.17-0.82)*		
≥ 30				0.89 (0.42-1.90)		
Systolic BP				1.01 (1.00-1.03)		
Diastolic BP				1.00 (0.97-1.04)		
Pos. Psych Variables						
Optimism					0.68 (0.54-0.87)*	
Positive Affect					1.21 (0.79-1.83)	
Neg. Psych Variables						
Anxiety						1.00 (0.60-1.66)
Cynical Hostility						1.19 (0.91-1.56)
Depression						1.03 (0.89-1.20)

*$p < .05$

CHAPTER IV

Purpose in life and use of preventive health care services

This chapter is adapted from my original paper "Purpose in life and preventive health care services" (Kim, Strecher, Ryff 2014).

Introduction

Three factors converge to underscore the heightened importance of preventive health care services among U.S. adults. First, the rapidly aging population: by 2050, the number of U.S. adults over the age of 65 is estimated to double (Vincent & Velkoff, 2010). Second, the rising cost of medical care: chronic illnesses and end of life issues that older adults face are expensive. The Congressional Budget office projects that spending on Medicare will nearly double as a share of GDP, from 3.7% in 2012 to 7.3% by 2050 (Congressional Budget Office, 2012). Third, despite spending more on health care than any country in the world, U.S. adults generally have poorer health and lower life expectancies than those in other developed countries (Banks, Marmot, Oldfield, & Smith, 2006; Woolf & Aron, 2013). This health disadvantage is not solely attributable to those who are poor and underprivileged, as even wealthy, educated Americans are in poorer health than their counterparts in comparable countries (Banks et al., 2006; Woolf & Aron, 2013).

These troublesome realities could be offset by greater use of preventive health care services, which are known to enhance health and reduce health care costs. However, in 2007 the

Brookings Institution estimates that only 4% of the $1.7 trillion spent on national health expenditures was for prevention (Lambrew, 2007). Older adults, in particular, use less preventive health care services than younger and middle-aged adults: they receive fewer cancer screenings, flu shots, mammograms, and pap smears (Chao, Paganini-Hill, Ross, & Henderson, 1987). In addition, less than 30% of adults aged 50-64 and less than 50% of adults over age 65 are up-to-date with core preventive services (Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 2011; Department of Health and Human Services, 2010). A central challenge therefore is to identify factors that may increase the likelihood of using preventive health care services. This need is particularly critical in the current climate, given that increased access to preventive care has become available with the Affordable Care Act.

The present study examines a psychological factor—purpose in life—as a potentially important influence on the use of preventive health care services. Conceived as a component of well-being, purpose addresses the extent to which individuals see their lives as having meaning, a sense of direction, and goals to live for (Frankl, 2006; McKnight & Kashdan, 2009; Ryff, 2014; Steger, Frazier, Oishi, & Kaler, 2006). The concept is often viewed as central to well-being and fulfillment in life (Frankl, 2006; Heintzelman & King, in press; King & Napa, 1998; McKnight & Kashdan, 2009; Ryff, 2014; Steger et al., 2006).

A growing body of findings from longitudinal epidemiological studies show that purpose predicts reduced morbidity (e.g., reduced risk of Alzheimer's disease and mild cognitive impairment, as well as reduced risk of stroke and myocardial infarction) and extended longevity (Boyle, Buchman, Barnes, & Bennett, 2010; Hill & Turiano, 2014; Kim, Sun, Park, & Peterson, 2013; Kim, Sun, Park, Kubzansky, & Peterson, 2013; Krause, 2009; Roepke, Jayawickreme, &

Riffle, 2013; Ryff, 2014). Further work has linked purpose to better regulation of physiological systems (e.g., reduced inflammatory markers and cardiovascular risk factors) as well as brain-based mechanisms (e.g., insular cortex volume, reduced amygdala activation, sustained ventral striatum activation; Bower, Kemeny, Taylor, & Fahey, 2003; Friedman, Hayney, Love, Singer, & Ryff, 2007; Friedman & Ryff, 2012; Heller et al., 2013; Lewis, Kanai, Rees, & Bates, 2013; Lindfors & Lundberg, 2002; Morozink, Friedman, Coe, & Ryff, 2010; Ryff, Singer, & Love, 2004; van Reekum et al., 2007). Additionally, a study that examined gene transcriptional profiles found that eudaimonic well-being (an overarching umbrella term that includes purpose) was associated with enhanced expression of antiviral response genes and reduced expression of proinflammatory genes (Fredrickson et al., 2013). Further, and perhaps most importantly, purpose, along with other components of psychological well-being have become the focus of multiple intervention studies designed to improve a person's life outlook (Breitbart et al., 2012; Fava & Tomba, 2009; Ruini & Fava, 2012; Ryff, 2014; van der Spek et al., 2014). Therefore, it may provide a point of intervention for improving health outcomes.

The exact mechanisms linking purpose with better health are unclear, but growing research suggests that people with higher purpose are more proactive in taking care of their health. To our knowledge only two studies have examined the association between purpose and preventive health care use, or health care use in general. One study examined 162 members from the Terman Study of the Gifted. Higher purpose was associated with higher profiles of exercise and relaxation as well as more accident prevention and regular checkups (Holahan & Suzuki, 2006). Another study, conducted in 80 women, showed that higher purpose was linked with better preventive behaviors for breast cancer (e.g., screenings and self-exams) (Wells & Bush, 2002). Both studies used cross-sectional designs and had relatively small samples that likely

suffer from sampling bias. For example, participants were selected into the first study (the Terman study) because they were intellectually gifted as children and the participants for the second study were recruited from a local health clinic. Further, neither study adjusted for potential confounders.

We build on this prior work and hypothesize that people with higher purpose are motivated to stay healthy and vital, and therefore are more likely to pursue preventive health care services (e.g., flu shots, cholesterol tests, colonoscopies, mammograms, pap smears, and prostate exams). As a result of engaging in preventive health care practices, we also hypothesize that people with higher purpose will spend fewer nights in the hospital. Overnight hospital visits are thus employed as a proxy for both poorer health and an expensive form of care that imposes a great burden on the health care system. Older adults (65+) account for 34% of hospital stays and 41% of hospital expenditures (Pfuntner, Wier, & Elixhauser, 2013). Each hospital stay for an older adult costs approximately $12,300 (Pfuntner et al., 2013).

We examine these hypotheses in a nationally representative sample of older U.S. adults. Our analyses adjust for sociodemographic factors, baseline health, health behaviors, and geographic factors—all factors previously linked with health care use. We further evaluate whether any observed associations between purpose and health care use hold after adjusting for facets of psychological ill-being (depression, anxiety, and negative affect), so as to underscore the unique benefits of purpose in life. Evidence that purpose is associated with health care use even after adjusting for these factors would reduce concerns that associations between purpose and health care use are primarily attributable to the mere absence of psychological ill-being. We also adjust for religiosity and positive affect, two factors that have been linked with health and

might confound the relationship between purpose and health care use (Park, 2007; Pressman & Cohen, 2005).

Method

Study Design and Sample

The Health and Retirement Study (HRS) is an ongoing nationally representative panel study of US adults aged 50 and older. It has interviewed respondents every two years since 1992, and new cohorts are added to keep the study sample representative (Sonnega et al., 2014). Over the course of the study it has interviewed over 37,000 people. The HRS is sponsored by the National Institute on Aging and is conducted by the University of Michigan (Sonnega et al., 2014). Starting in 2006, a random 50% of HRS respondents were assigned to undergo an enhanced face-to-face interview. A random 50% were selected because it was not financially feasible to provide enhanced face-to-face interviews for the entire HRS sample. At the end of the interview, respondents were given a self-report psychosocial questionnaire, which they completed and returned by mail to the University of Michigan. Among people who were interviewed, the response rate for the leave-behind questionnaire was 90% and the final sample consisted of 7,168 respondents. The HRS website provides extensive documentation about the protocol, instrumentation, and complex sampling strategy (http://hrsonline.isr.umich.edu/). Because the present study used de-identified, publicly available data, the Institutional Review Board at the University of Michigan exempted it from review.

Purpose In Life Measurement

Purpose in life was assessed using a seven-item questionnaire adapted from the Psychological Well-Being Scales, a measure with evidence of reliability and validity in a

nationally representative sample of adults (N=1,108) over the age of 25 (Ryff & Keyes, 1995). Although the original scale includes 20 items, several shortened versions of the scale, ranging from 3 to 14 questions, have been developed and psychometrically assessed (Abbott et al., 2006). A slightly altered version of the 7-item scale that was used in this study, has been psychometrically evaluated and validated in a previous large-scale study (Abbott et al., 2006).

On a six-point Likert scale, respondents rated the degree to which they endorsed items such as, "I have a sense of direction and purpose in my life" and "My daily activities often seem trivial and unimportant to me." Negatively worded items were reverse scored. The seven items were averaged (all items were summed together, then divided by seven) to create a scale that ranged from 1 to 6. Higher scores reflected greater levels of purpose (Cronbach $\alpha = 0.73$). In addition, we created tertiles of purpose to examine the possibility of threshold or discontinuous effects. The mean purpose scores by tertile were: 3.54 (low), 4.64 (moderate) and 5.56 (high).

Preventive Health Care Service Measurement

To identify visits that were made in the service of primary prevention, the number of respondents in our analyses changed depending on which preventive service was examined. For example, analyses for the prostate exam used only data from men with no history of cancer. Sensitivity analyses comparing models with and without adjustment for the relevant disease (e.g., including and excluding men with a history of cancer in the prostate exam analyses) indicated little difference in the estimated effects.

The outcome variables were measured in 2012. Each respondent was asked gender-specific questions regarding use (yes/no) of preventive health care services over the last two years (2010-2012). In total, HRS asked about six preventive measures recommended by either the United States Preventive Services Task Force (USPSTF), or the Centers for Disease Control

(CDC). Respondents were asked: In the last two years, have you had any of the following medical tests or procedures: A flu shot? A blood test for cholesterol? A colonoscopy, sigmoidoscopy, or other screening for colon cancer? A mammogram or x-ray of the breast to search for cancer? A pap smear? An examination of your prostrate to screen for cancer? The HRS preventive measures were evaluated by benchmarking them against other national surveys and have shown high reliability and validity (Jenkins, Ofstedal, & Weir, 2008).

Overnight Hospital Visit Measurement

The number of nights spent in the hospital was assessed using data from the 2008, 2010, and 2012 waves. During those waves, respondents were asked: "Have you been a patient in a hospital overnight?" If the respondent answered "no," the respondent was assigned a value of zero. If the respondent answered "yes," the respondent was then asked, "How many nights were you a patient in the hospital?" Overnight hospitalization reports from the 2008, 2010, and 2012 waves were summed to cover a six-year period from 2006 to 2012. Studies have also demonstrated that self-reported health care use shows substantial agreement with both medical records and administrative claims (Cleary & Jette, 1984; Reijneveld & Stronks, 2001; Ritter et al., 2001).

Baseline Covariates

All baseline covariates were assessed in 2006. Sociodemographic factors included: age, gender, race/ethnicity (Caucasian, African-American, Hispanic, Other), marital status (married/not married), educational attainment (no degree, GED or high school diploma, college degree or higher), total wealth (<25,000; 25,000-124,999; 125,000-299,999; 300,000-649,999; >650,000—based on quintiles of the score distribution in this sample), and health insurance status (yes/no).

Baseline health factors included an index of eight major chronic illnesses. For the chronic illness index, self-report of a doctor's diagnosis concerning eight major medical conditions was recorded at baseline: (1) high blood pressure, (2) diabetes, (3) cancer or malignant tumor of any kind (excluding minor skin cancer), (4) lung disease, (5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems, (6) emotional, nervous, or psychiatric problems, (7) arthritis or rheumatism, and 8) stroke. Self-reported health measures used in HRS have been rigorously assessed for their validity and reliability (Fisher, Faul, Weir, & Wallace, 2005; Sonnega et al., 2014).

Health behaviors included smoking status (never, former, current), frequency of exercise (never, 1-4 times per month, more than once a week), and frequency of alcohol consumption (abstinent, less than 1 or 2 days per month, 1 to 2 days per week, and more than 3 days per week).

Geographic factors included: urbanicity (urban, suburban, and rural) and region. To protect the identity of respondents, HRS automatically categorizes respondents into nine broad regions.

Statistical Analyses

Logistic regression was used in the analyses that examined preventive health care service use. For this set of analyses, all results can be interpreted as the change in odds of obtaining a preventive service as a function of a one unit increase in purpose in life (a six-point scale). For the analyses that examined overnight hospital visits, we used a generalized linear model with a negative binomial distribution and log link rather than an ordinary least squares regression. This statistical method appropriately models count data that has overdispersion and a skewed distribution. Due to the non-linear nature of the model, the estimated β coefficients were not directly interpretable. Therefore, to obtain more easily interpretable results, the coefficients

created by the model were exponentiated into rate ratio (RR) estimates using the eform command in Stata. We used HRS sampling weights in this study to account for the complex multistage probability survey design.

For analyses that examined the association between purpose and overnight hospitalizations, we examined the impact of the risk factors by creating a core model (Model 1) and then considered the impact of related covariates in turn. A total of five models were created. Model 1, the core model, adjusted for age, gender, race/ethnicity, marital status, education level, total wealth, and insurance status; Model 2 – core model + baseline health (index of eight major chronic illnesses), Model 3 – core model + health behaviors (smoking, exercise, and alcohol use); and Model 4 – core model + geographic factors (region and urbanicity). Although doing so could raise multicollinearity issues, we also created a Model 5, which included all covariates.

In analyses that examined the association between purpose and preventive health care services, we used a simpler model for two reasons. First, we included only factors that had been repeatedly identified in the literature as potential confounders. Two, presenting five covariate models for each of the six preventive health care services became unwieldy. Thus, in preventive health care service analyses we controlled for factors that were from the core sociodemographic model, which included: age, race/ethnicity, marital status, education level, total wealth, insurance status, and an index of eight major chronic illnesses.

Three additional analyses were performed. First, we examined if associations found between purpose and health care use (e.g., preventive health care use and number of nights spent in the hospital) were maintained after controlling for depression, anxiety, and negative affect. Using the core model, we added each psychological factor one at a time. Second, we examined if associations between purpose and health care use remained after controlling for positive affect or

religiosity. Third, we examined the data for a potential threshold effect by considering tertiles of purpose.

Missing Data

For all study variables, the overall item non-response rate was 6.36%. However, there was missing data across many variables. Thus, a complete case analysis (i.e. using data only from respondents with complete data on all variables) resulted in a 7.73%-42.44% loss of respondents, depending on which analysis was run (e.g., analyses examining pap smears only had a 7.73% loss of respondents when analyses were run only on respondents with no missing data, while analyses examining cholesterol tests had 42.44% loss of respondents). Therefore, to obtain less biased estimates, multiple imputation procedures were used to impute missing data. Sensitivity analyses showed that the results were maintained before and after the implementation of multiple imputations. We therefore used the dataset with multiple imputation for all analyses reported here, because so doing provides a more accurate estimate of association than other methods of handling missing data (Little & Rubin, 2002).

Results

Preventive Health Care Services

In models that adjusted for age, race/ethnicity, marital status, education level, total wealth, insurance status, and an index of major chronic illnesses, people with higher purpose in life did not have a higher likelihood of obtaining a preventive flu shot (OR = 1.04, 95% CI = 0.97-1.11; see Table 4.2 to view results from this paragraph). However, each unit increase in purpose (on a six-point purpose in life scale) was associated with a higher likelihood that people would obtain a cholesterol test (OR=1.18, 95% CI=1.08-1.29) or colonoscopy (OR=1.06, 95%

CI=0.99-1.14). Further, women with higher purpose were more likely to obtain a mammogram/x-ray (OR = 1.27, 95% CI = 1.16-1.39) or pap smear (OR = 1.16, 95% CI = 1.06-1.28), while men with higher purpose were more likely to obtain a prostate exam (OR = 1.31 95% CI = 1.18-1.45). Minimally adjusted models that only controlled for age showed similar patterns, except the strengths of association were stronger (Table S4.1).

Purpose and Number of Nights Spent in the Hospital

The average number nights spent in the hospital over the six-year follow-up was 7.21 (SD = 13.87). In the core model that adjusted for sociodemographic factors, each unit increase in purpose was associated with a 17% reduction in the number of reported nights spent in the hospital over the six-year follow-up (RR = 0.83, 95% CI = 0.77-0.89; Table 4.3, Model 1). The association between purpose and number of nights spent in the hospital were attenuated but remained in all of the subsequent covariate models (Table 4.3, Models 2-5).

Considering Other Psychological Factors

When negative psychological factors (depression, anxiety, negative affect) were sequentially added to the base model, they only modestly decreased the association between purpose and health care use (e.g., number of nights spent in the hospital and preventive health care use; data now shown). For example, when anxiety was added to the core model, which examined the association between purpose and number of nights spent in the hospital, the multivariate-adjusted RR for purpose was 0.87 (95% CI, 0.81-0.93). Similarly, when religiosity or positive affect were separately added to the base model, they only modestly decreased the association between purpose and health care use (e.g., number of nights spent in the hospital and preventive health care use; data now shown). Overall, the associations between purpose and health care use remained even after adjusting for these psychological factors. The benefits of

purpose in life for preventive health practice may also extend to other dimensions of Psychological Well-Being (See Supplemental Section).

Additional Analyses

When examining tertiles of purpose, the findings suggested a dose-response relationship between purpose and preventive health care use (Table S4.2). Increasing purpose was associated with a higher likelihood of preventive health care use. For example relative to women with the lowest purpose, women with moderate purpose were more likely to acquire a mammogram/x-ray (OR = 1.32 95% CI = 1.09-1.60;Table S4.2), while women with the highest purpose were the most likely to acquire a mammogram/x-ray (OR = 1.57 95% CI = 1.29-1.92). For some preventive health care services (e.g., colonoscopies and pap smears), the high purpose group was associated with preventive health care services but the moderate purpose group was not. However, a dose-response trend was still evident in all the analyses that examined preventive health care services.

When examining tertiles of purpose, a dose-response relationship also existed between purpose and number of nights spent in the hospital. For example, in the core model (Table S4.3, Model 1) relative to those with the lowest purpose, people with moderate purpose had a somewhat reduced number of nights spent in the hospital (RR = 0.77, 95% CI, 0.66-0.89), while those with the highest purpose spent the least number of nights in the hospital (RR = 0.67, 95% CI, 0.56-0.79.

Discussion

In a nationally representative sample of U.S. adults over the age of 50, higher purpose in life at baseline was prospectively associated with a higher likelihood of preventive health care

service use. Although higher purpose was not associated with a higher likelihood of obtaining a preventive flu shot, adults with greater purpose were more likely to obtain a cholesterol test or colonoscopy. In addition, women with higher purpose were more likely to obtain a mammogram or pap smear, while men with higher purpose were more likely to obtain a prostate exam. Further, after adjusting for sociodemographic factors each unit increase in purpose was associated with a 17% decrease in the number of nights spent in the hospital.

Past research has shown that negative psychological factors are associated with less preventive health care service use but higher overall health care use (Luppa et al., 2012; Thorpe, Thorpe, Kennelty, & Chewning, 2012). However, the present results showed that higher purpose in life was associated with greater use of preventive health care services and fewer overnight hospitalizations above and beyond the effects attributable to depression, anxiety, and negative affect. This outcome underscores the important point that psychological strengths, such as having meaning and direction in one's life, involves more than being free from emotional distress. Further, the association between purpose and health care use lasted (or remained marginally significant) after adjusting for a range of other covariates including sociodemographic factors, baseline health, health behaviors, geographic factors, religiosity, and positive affect.

The findings from this study may help explain the growing body of research that has linked higher purpose with positive physical, biological, and neural health. Physically, higher purpose has been linked with a wide range of positive health outcomes. For example, people with higher purpose not only live longer, but they also have a reduced risk of debilitating conditions such as stroke, myocardial infarction, loss of physical functioning, and Alzheimer's disease (Boyle, Buchman, Barnes, et al., 2010; Boyle, Buchman, & Bennett, 2010; Hill & Turiano, 2014; Kim, Sun, Park, & Peterson, 2013; Kim, Sun, Park, Kubzansky, et al., 2013;

Krause, 2009; Roepke et al., 2013; Ryff, 2014). Biologically, higher purpose has been linked with a healthier profile of biomarkers including lower levels of salivary cortisol, lower levels of sIL-6r (an important inflammatory factor), a lower waist-hip ratio, higher levels of HDL ("good" cholesterol), and healthier telomerase activity (Bower et al., 2003; Friedman et al., 2007; Jacobs et al., 2011; Lindfors & Lundberg, 2002; Ryff et al., 2004). Further, purpose may impact health through the immune system. In bereaved women who were participating in a distress-alleviating intervention, women showing greater increases in purpose also showed the greatest increases in natural killer cell activity (Bower et al., 2003). Neurally, researchers used functional magnetic resonance imaging (MRI) to examine how people's amygdala activation differed in response to negative versus neutral stimuli. People with higher purpose displayed increased ventral anterior cingulated cortex activation and reduced amygdala activation (van Reekum et al., 2007). Another study used structural MRI and found that purpose was positively associated with right insular cortex grey matter and negatively associated with middle temporal gyrus grey matter (Lewis et al., 2013). Further, functional MRI scans from another study revealed that when people were shown positive stimuli, people with higher eudaimonic well-being (an overarching umbrella term that includes purpose) displayed sustained ventral striatum and dorsolateral prefrontal cortex activity (Heller et al., 2013).

The links between higher purpose and enhanced physical, biological, and neural health suggest that the benefits of purpose are broad, impacting several areas of the body and mind that are relevant to health (see Ryff, 2014 and Roepke, Jayawickreme, & Riffle, 2013 for recent reviews on this topic). However, few studies have examined the mechanisms that might explain the links described above. This study suggests that the proactive preventive health care behaviors people with higher purpose perform, result in positive health outcomes. Future research should

further examine if preventive health care behaviors are indeed a mechanism by which purpose enhances health.

Viktor Frankl is one of the first modern day scientists to write extensively about purpose in life. Based on his profound experiences in Nazi concentration camps, he created several theories on why a greater purpose in life might help people live longer. In one theory, he hypothesized that people with higher purpose are able to live longer because they have a greater will to live (Frankl, 2006). Echoing a sentiment spoken by Nietzsche, Frankl said, "Those who have a 'why' to live, can bear with almost any 'how.'" In the context of this study, people with higher purpose may act in healthier ways and take more preventive steps because they have a greater will to live, which incentives them to take preventive measures that may seem time consuming, costly, fear inducing (e.g., a parent had cancer so a person may be afraid of cancer screening results), or even painful. Past research examining the links between purpose and behavioral outcomes converge with findings from this study. People with higher purpose are more likely to get exercise and relax as well as to acquire more regular checkups (Holahan & Suzuki, 2006; Holahan et al., 2011; Wells & Bush, 2002). All of these activities may be prompted by an overarching outlook in which life itself is greatly valued. This study had many limitations and strengths. The present findings rely on self-reported health care use, which may be open to bias. However, the validity of self-reported health care use has been replicated in a range of samples, where self-reported health care use shows high agreement with medical records and administrative claims (Cleary & Jette, 1984; Reijneveld & Stronks, 2001; Ritter et al., 2001). Further, the HRS preventive measures were evaluated by benchmarking them against other national surveys and shown to have high reliability and validity (Fisher et al., 2005). Even so, future studies should examine the association between purpose and health care use using

medical records or administrative claims. It is also unclear why purpose was not associated with more flu shots even though it was associated with five other preventive behaviors (cholesterol tests, colonoscopies, mammograms/x-rays, pap smears, and prostate exams). One possible explanation is related to question wording (i.e., getting a flu shot from one's doctor), given that many people get free flu shots at work, local community centers, or religious centers. Further, this study did not assess illness behavior or related constructs. Illness behavior helps explain the different ways in which people perceive, evaluate and respond to symptoms (Sirri, Fava, & Sonino, 2013). Future studies should examine how illness behavior impacts the association between purpose and health care use.

Despite these limitations this study was conducted in a large, nationally representative sample of U.S. adults over the age of 50. The prospective nature of the data minimized concerns that obtained associations were due to retrospective reporting bias, or reverse causality. We were also able to assess the association between purpose and health care use after adjusting for a wide array of covariates. Further, a widely used and validated measure of purpose was used.

Several promising interventions have shown that purpose, along with other facets of psychological well-being, can be improved for greater segments of the population (Davidson & McEwen, 2012; Ryff, 2014). Further, growing evidence suggests that interventions (that are overtly designed to enhance well-being) can improve behavioral and biological outcomes in lasting ways (Davidson & McEwen, 2012). Ryff (2014) reviewed over a dozen psychiatric intervention studies that have used various techniques (e.g., cognitive behavioral therapy, meditation, emotional disclosure) to enhance facets of psychological well-being (Ryff, 2014). An example of a promising intervention is a type of cognitive behavioral approach called Well-Being Therapy. The technique has been shown to effectively help people suffering from a wide

range of psychological disorders to achieve optimal levels of psychological well-being (Fava & Tomba, 2009; Ruini & Fava, 2012). The technique is typically used after standard care (e.g., CBT and/or pharmacotherapy) and is known to help prevent relapse. Further, early randomized controlled trials have shown that a meaning-centered therapy, delivered either in a group or individual format, can help raise meaning and purpose in life among people with cancer (Breitbart et al., 2012; van der Spek et al., 2014). Finally, as people retire, several volunteering programs have emerged which help older adults transition into meaningful and socially engaging activities—likely enhancing their sense of purpose in life (e.g., Experience Corp, Retired and Senior Volunteer Program, Foster Grandparents) (Heaven et al., 2013). Future studies should systematically examine how these programs impact levels of purpose among its volunteers.

The practical implication of the present findings are that people with higher purpose use more preventive health care services and impose less of a burden on the health care system. In 2011, people made approximately 38.6 million hospital stays in the United States—the aggregated cost of these stays was $387 billion (Pfuntner et al., 2013). Considering our rapidly aging population, which will likely use increasing amounts of health care, the difference in health care costs incurred by people with the most versus least purpose might be substantial. Building on needed replication of the present findings, intervention studies designed to improve experiences of purpose in life may be warranted. Doing so could offer new avenues for increased use of preventive health care use, thereby decreasing health care costs, and enhancing quality of life among those moving into the ranks of our aging society.

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Table 4.1. Descriptive statistics*

Mean Purpose (SD)	4.52 (0.93)
Mean Age (SD)	69.06 (9.84)
Female	4139 (57.74)
Race/Ethnicity	
Caucasian	5607 (78.22)
African-American	936 (13.06)
Hispanic	527 (7.35)
Other	98 (1.37)
Married Status	4639 (64.72)
Education	
< High School	1366 (19.07)
High School	3952 (55.14)
≥ College	1850 (25.80)
Total Wealth	
1st Quintile	1437 (20.05)
2nd Quintile	1431 (19.96)
3rd Quintile	1436 (20.03)
4th Quintile	1431 (19.96)
5th Quintile	1433 (19.99)
Mean # of Chronic Illnesses (SD)	2.11 (1.43)
Smoking Status	
Never	3116 (43.47)
Former Smoker	3145 (43.88)
Current Smoker	907 (12.65)
Exercise	
Never	4528 (63.17)
1-4 times per month	1008 (14.05)
More than 1x per week	1632 (22.77)
Alcohol Frequency (days/week)	
Never	3486 (48.63)
<1	1300 (18.14)
1-2	1134 (15.82)
3+	1248 (17.40)
Insured	6850 (95.58)
Urbanicity	
Urban	3332 (46.49)
Suburban	1535 (21.41)
Rural	2301 (32.10)

*Unless otherwise noted, values are number of participants (percentage)

Table 4.2. Odds ratios for the association between purpose and preventive health care services*

Health Service Measure	Adjusted OR (95% CI)	P-value	Prevalence
Preventive flu shot[a]	1.04 (0.97-1.11)	0.255	64.03%
Cholesterol test[b]	1.18 (1.08-1.29)	< 0.001	76.52%
Colonoscopy[c]	1.06 (0.99-1.14)	0.076	27.24%
Mammogram / X-ray[d]	1.27 (1.16-1.39)	< 0.001	59.59%
Pap smear[d]	1.16 (1.06-1.28)	0.001	33.44%
Prostate exam[e]	1.31 (1.18-1.45)	< 0.001	57.61%

*All models controlled for the following covariates: age, race/ethnicity, marital status, education level, total wealth, insurance status, index of major chronic illnesses

[a]n=7,168

[b]Only people with no history of heart disease or stroke (n=5,160)

[c]Only people with no history of cancer (n=6,070)

[d]Only women with no history of cancer (n=3,535)

[e]Only men with no history of cancer (n=2,534)

Table 4.3. Rate ratios for the association between purpose and number of nights spent in the hospital

Model	Covariates	Adjusted RR (95% CI)	P-value
1	Core sociodemographic factors*	0.83 (0.77-0.89)	< 0.001
2	Demographic* + baseline health[†]	0.89 (0.83-0.95)	0.002
3	Demographic* + health behaviors[‡]	0.87 (0.81-0.93)	< 0.001
4	Demographic* + geographic[§]	0.83 (0.78-0.89)	< 0.001
5	All covariates[¶]	0.92 (0.86-0.99)	0.021

*__Core sociodemographic factors:__ age, gender, race/ethnicity, marital status, education level, total wealth, insurance status

[†]__Baseline health:__ index of major chronic illnesses

[‡]__Health behaviors:__ smoking, exercise, alcohol use

[§]__Geographic:__ region, urbancity

[¶]__All covariates:__ age, gender, race/ethnicity, marital status, education level, total wealth, insurance status, index of major chronic illnesses, smoking, exercise, alcohol use, region, urbancity

Supplemental Information

Measurement of Psychological Factors. Psychological factors included depression, anxiety, negative affect, positive affect, religiosity, personal growth, and self-acceptance. These factors were assessed using measures that have been rigorously evaluated and shown good reliability and validity in previous studies. Depression was measured using the Center for Epidemiological Studies Depression Scale (CES-D) (in HRS, M = 1.43, SD = 1.94, Cronbach $\alpha = 0.88$), anxiety was measured using the Beck Anxiety Inventory (in HRS, M = 1.57, SD = 0.58, Cronbach $\alpha = 0.81$), negative affect and positive affect were measured using a twelve-item scale that was developed for use in nationally representative datasets (negative affect in HRS, M = 1.64, SD = 0.66, Cronbach $\alpha = 0.90$; positive affect in HRS, M = 3.58, SD = 0.69, Cronbach $\alpha = 0.91$), religiosity was measured using the Brief Multidimensional Measure of Religiousness/Spirituality (in HRS, M = 5.13, SD = 1.38, Cronbach $\alpha = 0.91$), and finally personal growth (in HRS, M = 5.52, SD = 0.92, Cronbach $\alpha = 0.76$) and self-acceptance (in HRS, M = 4.63, SD = 0.94, Cronbach $\alpha = 0.82$) were measured using the Psychological Well-Being Scales.

Personal growth and self-acceptance. HRS already collects information about personal growth and self-acceptance—two other dimensions of Psychological Well-Being. Therefore, in an exploratory manner, we examined the association between personal growth and self-acceptance with preventive health care use and overnight hospitalizations. We found that both personal growth and self-acceptance were associated with more preventive health care use and fewer overnight hospitalizations. The pattern of results and the size of the associations were similar

when compared to purpose in life. Although these factors have received notably less research in the context of health, these important factors should be more fully explored in future research.

Table S4.1. Odds ratios for the association between purpose and preventive health care services (basic model)*

Health Service Measure	Adjusted OR (95% CI)	P-value	Prevalence
Preventive flu shot[a]	1.05 (0.99-1.12)	0.090	64.03%
Cholesterol test[b]	1.21 (1.12-1.31)	< 0.001	76.52%
Colonoscopy[c]	1.11 (1.04-1.19)	0.001	27.24%
Mammogram / X-ray[d]	1.36 (1.25-1.48)	< 0.001	59.59%
Pap smear[d]	1.25 (1.15-1.37)	< 0.001	33.44%
Prostate exam[e]	1.41 (1.28-1.56)	< 0.001	57.61%

*All models were age adjusted

[a]n=7,168

[b]Only people with no history of heart disease or stroke (n=5,160)

[c]Only people with no history of cancer (n=6,070)

[d]Only women with no history of cancer (n=3,535)

[e]Only men with no history of cancer (n=2,534)

Table S4.2. Odds ratios for the association between purpose and preventive health care services (by tertile)*

Model	Tertile Group	Adjusted rate ratios (95% CI)	P-value
Preventive flu shot[a]	Low (Reference Group)	1.00	
	Moderate	1.09 (0.95-1.25)	0.204
	High	1.01 (0.88-1.16)	0.878
Cholesterol test[b]	Low (Reference Group)	1.00	
	Moderate	1.28 (1.06-1.55)	0.009
	High	1.40 (1.15-1.70)	0.001
Colonoscopy[c]	Low (Reference Group)	1.00	
	Moderate	1.08 (0.93-1.26)	0.308
	High	1.19 (1.02-1.38)	0.025
Mammogram/ X-ray[d]	Low (Reference Group)	1.00	
	Moderate	1.32 (1.09-1.60)	0.005
	High	1.57 (1.29-1.92)	< 0.001
Pap smear[d]	Low (Reference Group)	1.00	
	Moderate	1.13 (0.93-1.38)	0.228
	High	1.37 (1.12-1.67)	0.002
Prostate exam[e]	Low (Reference Group)	1.00	
	Moderate	1.38 (1.10-1.72)	0.005
	High	1.55 (1.23-1.95)	< 0.001

*All models were adjusted for age, gender, race/ethnicity, marital status, education level, total wealth, insurance status, an index of major chronic illnesses

[a]n=7,168

[b]Only people with no history of heart disease or stroke (n=5,160)

[c]Only people with no history of cancer (n=6,070)

[d]Only women with no history of cancer (n=3,535)

[e]Only men with no history of cancer (n=2,534)

Table S4.3. Rate ratios for the association between purpose and number of nights spent in the hospital (by tertile)

Model	Tertile Group	Adjusted rate ratios (95% CI)	P-value
1*	Low (Reference Group)	1.00	
	Moderate	0.77 (0.66-0.89)	0.001
	High	0.67 (0.56-0.79)	< 0.001
2*†	Low (Reference Group)	1.00	
	Moderate	0.83 (0.72-0.95)	0.010
	High	0.75 (0.64-0.89)	0.001
3*‡	Low (Reference Group)	1.00	
	Moderate	0.81 (0.70-0.93)	0.003
	High	0.72 (0.62-0.85)	< 0.001
4*§	Low (Reference Group)	1.00	
	Moderate	0.77 (0.66-0.89)	0.001
	High	0.67 (0.57-0.79)	< 0.001
5*¶	Low (Reference Group)	1.00	
	Moderate	0.86 (0.75-0.99)	0.034
	High	0.80 (0.68-0.94)	0.008

*__Core sociodemographic factors:__ age, gender, race/ethnicity, marital status, education level, total wealth, insurance status

†__Baseline health:__ index of major chronic illnesses

‡__Health behaviors:__ smoking, exercise, alcohol use

§__Geographic:__ region, urbancity

¶__All covariates:__ age, gender, race/ethnicity, marital status, education level, total wealth, insurance status, index of major chronic illnesses, smoking, exercise, alcohol use, region, urbancity

CHAPTER V

Examining behavioral mechanisms involved in the association between purpose in life and myocardial infarction: A structural equation modeling approach

Introduction

Research in health psychology has historically focused on alleviating disease and dysfunction. The majority of research has focused on the association between psychological ill-being (e.g., depression, anxiety, hostility) and negative health outcomes. Recently, a growing body of research shows that purpose in life is uniquely associated with several positive health outcomes across a large and diverse array of samples (Roepke, Jayawickreme, & Riffle, 2013; Ryff, 2014). For example, longitudinal studies have shown that higher purpose has been linked with reduced risk of stroke, heart attack, and Alzheimer's disease (Boyle et al., 2010; Kim, Sun, Park, & Peterson, 2013; Kim, Sun, Park, Kubzansky, & Peterson, 2013).

Facets of positive psychological functioning, such as purpose in life, are important to examine because the mere absence of psychological ill-being does not indicate the presence of positive psychological functioning, in fact both broad constructs have unique biological correlates (Ryff et al., 2006). Further, purpose in life is shaped by social influences and intervention trials have shown that purpose can be enhanced (Burrow & Hill, 2011; Hill, Burrow, & Sumner, 2013; Ruini & Fava, 2012; van der Spek et al., 2014b). While some interventions are more time-intensive, others are relatively brief and straightforward, and easily implementable in practice. Therefore, with proper tailoring, existing interventions (and interventions currently

being developed) that raise purpose in life can become candidates for interventions that improve health outcomes.

Yet, the mechanisms through which purpose in life influences health are unclear. Several authors have highlighted the need to identify and further investigate these mechanisms (Boehm & Kubzansky, 2012b; Kim, Strecher, & Ryff, 2014; Ryff, 2014). These mechanisms are important to identify because their identification will help advance theoretical models. In turn, researchers can use these models to create health interventions. Further, these mechanisms can serve as intermediate outcomes in trial studies. Intermediate outcomes are important to study because initial randomized controlled trial studies in new areas of research are small in scale with short follow-up times. These small studies will not have enough participants who develop heart attacks, strokes, or other major (but rare) health outcomes that previous research in this area has examined. However, small trial studies will have enough participants and a long enough follow-up period to detect changes in intermediate factors such as health behaviors. Further, improvement in these intermediate outcomes themselves provide important health benefits. Accumulating evidence suggests that interventions which reduce obesity, hypertension, and diabetes (even in people aged 50+) result in added years of life and reduced lifetime medical spending (Goldman et al., 2009).

One of the more popular theoretical models hypothesizes that facets of positive psychological functioning, such as purpose in life, influence health through health behaviors (Boehm & Kubzansky, 2012b; Pressman & Cohen, 2005). Past research supports this hypothesis and has found that people with higher purpose tend to act in healthier ways. For example, people with higher purpose are more physically active (measured through both self-report and objective measures (e.g., accelerometer)), they participate in more preventive health care behaviors (such

as cholesterol tests and cancer screenings), they tend to smoke less, and they also have higher sleep quality (Holahan et al., 2011; Holahan, Holahan, & Suzuki, 2008; Hooker & Masters, 2014; Kim et al., 2014; Konkolÿ Thege, Bachner, Kushnir, & Kopp, 2009; Konkolÿ Thege, Bachner, Martos, & Kushnir, 2009; Konkolÿ Thege, Stauder, & Kopp, 2010; Konkolÿ Thege, Urbán, & Kopp, 2013; Steptoe, Wright, Kunz-Ebrecht, & Iliffe, 2006; Strong et al., 2009).

Studies have linked purpose in life with health behaviors in the past. Others have adjusted for health behaviors and found that the association between purpose in life and health are reduced, implying mediation. However, no study has directly tested if health behaviors mediate the relationship between purpose in life and health using structural equation modeling. The aim of this paper is to build on previous research and address this gap by investigating the possible mediating role that health behaviors might play between purpose in life and myocardial infarction using structural equation modeling. This statistical framework allows researchers to decompose effects and simultaneously test multiple mediating pathways, which is important because it helps researchers avoid confounded mediation. This framework also allows researchers to examine direct and indirect effects between purpose in life and myocardial infarction.

I hypothesized that physical activity, sleep quality, smoking, and cholesterol tests would mediate the association between purpose in life and myocardial infarction. All models in this study adjusted for sociodemographic factors that have been linked with risk of cardiovascular disease. Three alternate hypotheses were also tested. First, I explored whether the associations found in the main hypothesis would hold after adjusting for facets of psychological ill-being (depression, anxiety, and cynical hostility—all factors that have previously been shown to predict cardiovascular events) in order to highlight the unique benefit of purpose in life. Past

studies found that poor health behaviors mediate the association between psychological ill-being and increased risk of cardiovascular disease. If the mediators between purpose in life and myocardial infarction remained after adjusting for the different facets of psychological ill-being, it would diminish concerns that the associations found with the mediators are primarily attributable to the mere absence of psychological ill-being. I explored a second alternate hypothesis and examined whether people with higher purpose in life might merely have higher baseline health. Hence, purpose would serve as a mere proxy for health. If the mediators between purpose in life and myocardial infarction remained after adjusting for baseline health, it would reduce concerns that the association found with the mediators are primarily attributable to healthier people reporting higher purpose in life. I explored a third and final alternate hypothesis. Here I examined whether the associations found in the main hypothesis would remain after adjusting for baseline health behaviors. Baseline levels of physical activity, sleep quality, and smoking were available for analysis while baseline use of cholesterol tests was not collected by HRS. If the mediators between purpose in life and myocardial infarction remained after adjusting for the baseline health behaviors, it would diminish concerns that the associations found with the mediators are primarily attributable to the fact that people with higher purpose were simply acting in healthier ways at baseline. Hence, the follow-up health behaviors measured in 2008 would simply be a continuation of better health behaviors that were already occurring at baseline in 2006. Adjusting for baseline health behaviors would attenuate these concerns.

Older adults are an important age group to examine because the United States population of older adults is rapidly expanding (the number of people aged 65+ is expected to double by 2030) and the Congressional Budget office projects that spending on Medicare will nearly double as a share of GDP, from 3.7% in 2012 to 7.3% by 2050 (Congressional Budget Office,

2012; Vincent & Velkoff, 2010). This rise in medical costs due to an aging population will likely reach beyond Medicare.

Despite spending considerably more on health care than any other country in the world, U.S. adults generally suffer from poorer health and lower life expectancies than others in developed countries. This health disadvantage is not exclusively attributable to people who are poor and underprivileged, because even wealthy, educated Americans have poorer health than their counterparts in comparable countries (Avendano et al., 2009; Banks, Marmot, Oldfield, & Smith, 2006). Therefore, there is a need to develop the basic science that can translate into practical and inexpensive interventions that can simultaneously enhance health and reduce the health care costs of aging adults.

Method

Study Design and Sample

The Health and Retirement Study (HRS) is a nationally representative panel study of US adults aged 51 and older. It has interviewed respondents since 1992 and continues interviewing the same respondents every two years (Sonnega et al., 2014). However, new cohorts are added to keep the study sample representative. Over the course of the study HRS has interviewed over 37,000 people. Starting in 2006, a random 50% of HRS respondents were assigned to undergo an enhanced face-to-face interview. A random 50% were selected because it was not financially feasible to provide enhanced face-to-face interviews for the entire sample. At the end of the interview, respondents were given a self-report psychosocial questionnaire, which they completed and returned by mail to the University of Michigan. Among people who were interviewed, the response rate for the leave-behind questionnaire was 90% resulting in 7,168

respondents. Respondents who self-reported a history of heart disease at baseline (1,816 people) were excluded. There was an additional 150 respondents (2.8% of respondents) who were excluded from the analyses because of missing data on the exogenous variables (e.g., purpose in life and covariates). Therefore, the final sample consisted of 5,202 respondents. In this study, participants were tracked over a period of six years, from the 2006 wave to the 2012 wave.

The HRS website provides extensive documentation about the protocol, instrumentation, and complex sampling strategy (http://hrsonline.isr.umich.edu/). Because the present study used de-identified, publicly available data, the Institutional Review Board at the University of Michigan exempted it from review. The HRS is sponsored by the National Institute on Aging and is conducted by the University of Michigan.

Measures

Purpose in Life. Purpose in life was assessed using a seven-item questionnaire adapted from the Psychological Well-Being Scales, a measure with evidence of validity and reliability in a large sample of adults (N=1,108) over the age of 25 (Ryff & Keyes, 1995). The original scale includes 20 items. However, several shortened versions of the scale ranging from 3 to 14 questions have been developed and psychometrically assessed (Abbott et al., 2006). A slightly modified version of the 7-item scale that was used in this study, has been psychometrically evaluated and validated in a previous large-scale study (Abbott et al., 2006). On a six-point Likert scale, respondents rated the degree to which they endorsed items such as, “I have a sense of direction and purpose in my life,” “I enjoy making plans for the future and working to make them a reality,” and “I don’t have a good sense of what it is I’m trying to accomplish in life.” Negatively worded items were reverse scored. The seven items were averaged to create a scale that ranged from 1 to 6 with higher scores reflecting greater levels of purpose in life.

Covariates. All baseline covariates were assessed in 2006 and include the following variables which have known associations with cardiovascular risk: age, gender, race/ethnicity (Caucasian, African-American, Hispanic), marital status (married/not married), educational attainment (no degree, GED or high school diploma, college degree or higher), and total wealth (<25,000; 25,000-124,999; 125,000-299,999; 300,000-649,999; >650,000—based on quintiles of the score distribution in this sample).

Baseline health factors included an index of eight major chronic illnesses and a 23-item measure of physical functioning. For the chronic illness index, self-report of a doctor's diagnosis concerning eight major medical conditions was recorded at baseline: (1) high blood pressure, (2) diabetes, (3) cancer or malignant tumor of any kind (excluding minor skin cancer), (4) lung disease, (5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems, (6) emotional, nervous, or psychiatric problems, (7) arthritis or rheumatism, and 8) stroke. Self-reported health measures used in HRS have been rigorously assessed for their validity and reliability (Fisher, Faul, Weir, & Wallace, 2005; Sonnega et al., 2014). Physical functioning was assessed using items adapted from scales developed by Rosow and Breslau (1966), Nagi (1976), Katz, Ford, Moskowitz, Jackson, and Jaffe, 1963, and Lawton and Brody (1969). Physical functioning was conceptualized as a multidimensional construct that assessed general mobility, large-muscle functioning, gross motor skills, fine motor skills, and the ability to execute a variety of activities of daily living and instrumental activities of daily living. Respondents were asked if they experienced difficulty with a series of activities such as running or jogging a mile, climbing stairs, bathing, and getting up from a chair (max = 23). The present analyses used a count of reported limitations, where higher values indicated more limitations.

Physical Activity Frequency. Frequency of vigorous and moderate physical activity was assessed by asking respondents two sets of questions. Vigorous physical activity was assessed by asking respondents "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?" Moderate physical activity was assessed by asking respondents "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 physical activities." Frequency of moderate and vigorous activity were combined and respondents were placed into three categories of physical activity frequency: never, 1-4 times per month, more than once a week.

Sleep Quality. Sleep quality was assessed by asking respondents "how often do you feel really rested when you wake up in the morning?" Potential responses included: "most of the time," "sometimes," and "rarely or never."

Smoking Status. Current smoking status was assessed by asking respondents "Do you smoke cigarettes now?"

Cholesterol Test. Respondents were asked: In the last two years, have you had any of the following medical tests or procedures including, "A blood test for cholesterol?" HRS preventive measures were evaluated by benchmarking them against other national surveys and have shown high reliability and validity (Fisher et al., 2005).

Myocardial Infarction Outcome Measurement. Myocardial infarction was defined as a nonfatal or fatal myocardial infarction based on self or proxy-report of a physician's diagnosis using the 2010 and 2012 waves and exit surveys. Myocardial infarctions that are assessed through self-report correspond imperfectly with medical records. Although imperfect, the high

agreement between self-reported myocardial infarctions and hospital records has been well documented (Heckbert et al., 2004; Klungel, de Boer, Paes, Seidell, & Bakker, 1999; Machón et al., 2013; Okura, Urban, Mahoney, Jacobsen, & Rodeheffer, 2004). For example, in a recent longitudinal study of 41,438 Spanish adults, self-reported myocardial infarctions were compared against hospital records. The sensitivity of self-reported acute myocardial infarction was 97.7%, with a specificity of 99.7% and positive predictive value of 60.7% (Machón et al., 2013). Also, self-report data are particularly precise for acute events like myocardial infarction (Okura et al., 2004).

Analytic Plan

Using the structural equation modeling framework, a series of analyses were conducted to examine the association between purpose in life and cardiovascular health and whether four health behaviors (physical activity, sleep quality, smoking, and cholesterol tests) mediate this association. The multiple mediation model was used because several health behaviors were hypothesized to simultaneously mediate the association between purpose and cardiovascular health. The multiple mediation model allows researchers to decompose effects and simultaneously test multiple mediating pathways while also adjusting for the effects of the other mediators—this capability allows researchers to avoid confounded mediation (Preacher & Hayes, 2008). This framework also allows researchers to examine direct and indirect effects between purpose in life and cardiovascular health. The total indirect effects (sum of indirect effects across all mediators) and specific indirect effects (indirect effect of a particular mediator) between purpose in life and cardiovascular health were examined. All models in this study adjusted for age, gender, race/ethnicity, marital status, education, and total wealth. Missing data was treated using maximum likelihood estimation (except for 150 respondents whose data was

dropped because missing data on exogenous variables could not be modeled). HRS sampling weights were used in this study to account for the complex multistage probability survey design. All analyses were conducted using Mplus Version 7.3 (Muthén & Muthén, 1998-2014).

Criteria Used to Assess Goodness of Fit

The goodness of fit between the structural model and the data was examined using the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), Comparative Fit Index (CFI; Bentler, 1990), and the standardized root mean square of approximation (RMSEA; Steiger, 1990). TLI and CFI values of .95 or more indicate strong fit while any values over .90 indicate adequate fit. For RMSEA, values of .60 and below indicate strong fit while values of .80 and below indicate reasonable fit (Hu & Bentler, 1999; Kline, 2005). A number of researchers have noted that the χ^2 statistic is highly sensitive to sample size (e.g., sample sizes of more than 200). Therefore χ^2 may not be the optimal test in a large study like the present study which has over 5,000 respondents (Bollen, 1989; Chen, 2007). For this reason, an alternate method of evaluating the χ^2 statistic that is more suitable for large sample sizes was used. The χ^2/degrees of freedom ratio was examined—a value of 3 or less indicates good model fit (Kline, 2005).

Bootstrapping To Examine Indirect Effects.

The indirect effects and 95% bias-corrected confidence intervals were calculated using the bootstrap method of Preacher and Hayes (Preacher & Hayes, 2008). One thousand bootstrap samples (using the original dataset) were created using random sampling with replacement. This method has been argued as a superior method compared to the Sobel test because it does not require that the indirect effect has a normal sampling distribution (Preacher & Hayes, 2008; Shrout & Bolger, 2002). If this confidence interval does not include zero, the indirect effect is considered statistically significant at the .05 level.

Results

Descriptive Statistics

Over the four year period from 2008 to 2012, 209 respondents had a myocardial infarction, 387 had a stroke, and 198 had heart failure. At baseline the mean age of respondents was 67.64 years (SD = 9.51). Respondents were 77.53% European-American, 13.00% African-American, 8.04% Hispanic, and 1.44% were in the "Other" category. About 59.77% of respondents were women. The majority of respondents were married (65.15%). Some respondents did not graduate high school (17.22%), most acquired a high school degree (55.13%), while others acquired a college degree or higher degree (27.64%). Physically, respondents reported about 1.64 chronic illnesses out of a possible eight (SD = 1.17) and also reported having an average of 3.30 physical functioning problems out of a possible 23 (SD = 3.78). At baseline (2006), 13.36% were current smokers. Concerning physical activity, 16.17% never performed physical activity, 22.01% did so 1-4 times per month, while 61.82% did so more than once a week. Further, when asked "how often do you feel really rested when you wake up in the morning?" 13.46% responded rarely or never, 23.37% respondents sometimes, and 63.17% responded most of the time. The percentage of people who received cholesterol tests was not assessed at baseline.

In 2008, 10.82% were current smokers. Concerning physical activity, 17.13% never performed physical activity, 24.64% did so 1-4 times per month, while 58.23% did so more than once a week. Further, when asked "how often do you feel really rested when you wake up in the morning?" 10.28% responded rarely or never, 29.48% respondents sometimes, and 60.23% responded most of the time. Finally 84.17% had cholesterol tests. The descriptive statistics are

displayed in Table 5.1 and Table 5.2. Further, as shown in Table 5.3, all variables were correlated with each other in the expected direction. Table 5.4 shows the changes in health behaviors from baseline to follow-up.

Testing the Structural Model

The goodness of fit measures that were used to examine the hypothesized model showed that the initial model was a poor fit ($\chi^2(6)$ value of 120.408 (CFI = .899; TLI = .072; RMSEA = .030, 90% CI = .051, .070). The Wald test was examined and based on theoretical relevance, changes were made. The Wald test suggested covarying physical activity with sleep quality. The model was reestimated after making this change. However, the goodness of fit measures still suggested an insufficient fit ($\chi^2(5)$ value of 38.635 (CFI = .970; TLI = .673; RMSEA = .036, 90% CI = .026, 047). The Wald test was examined again and it suggested covarying physical activity with smoking status. The model was reestimated after this second change and the goodness of fit measures still suggested an insufficient fit ($\chi^2(4)$ value of 18.982 (CFI = .987; TLI = .818; RMSEA = .027, 90% CI = .015, .040). The Wald test suggested covarying smoking with cholesterol tests. The model was reestimated after this last change and all the goodness of fit measures indicated that the model was a good fit of the data ($\chi^2(3)$ value of 4.499 (CFI = .999; TLI = 976; RMSEA = .010, 90% CI = .00, .027). Further the χ^2/df ratio was 1.499, signifying a good model fit.

The main hypothesis was tested by examining the significance of the path coefficients. Although not shown in the diagrams, all models in this study adjusted for age, gender, race/ethnicity, marital status, education, and total wealth. The significant paths were partially consistent with the hypothesized model (see Table 5.5). Higher levels of purpose in life at baseline predicted higher levels of physical activity (β = .203; 95% CI = .160, .246), higher

quality sleep (β = .189; 95% CI = .155, .222), and lower levels of smoking (β = -.114; 95% CI = -.180, -.048). However, purpose did not predict use of cholesterol tests (β = -.025; 95% CI = -.084, .034). Further, smoking (β = .125; 95% CI = -.005, .256) predicted higher risk of myocardial infarction—though this association wasn't technically significant it was marginally so. Higher physical activity predicted lower risk of myocardial infarction (β = -.128; 95% CI = -.205, -.051). However, higher sleep quality (β = -.004; 95% CI = -.078, .070) and use of cholesterol tests (β = .082; 95% CI = -.028, .193) did not predict risk of myocardial infarction. There was no direct effect of purpose in life on risk of myocardial infarction (β = -.023; 95% CI = -.105, .059).

Indirect Effects

The analyses showed that a total indirect effect existed between purpose in life and myocardial infarction through the four mediators (β = -.045; 95% CI = -.070, -.020). When examining the indirect effect of each mediator, analyses revealed that purpose in life predicted risk of myocardial infarction through physical activity (β = -.026; 95% CI = -.042, -.009) and smoking (β = -.016; 95% CI = -.035, .004; although the association was marginally significant) but not through sleep quality (β = -.001; 95% CI = -.015, .013) or use of cholesterol tests (β = -.003; 95% CI = -.011, .006).

Alternate Hypotheses

To help rule out alternate hypotheses, three additional models were tested. First, I explored whether the associations found in the main hypothesis would hold after adjusting for facets of psychological ill-being (depression, anxiety, and cynical hostility—all factors that have previously been shown to predict cardiovascular events) in order to highlight the unique benefit of purpose in life. In analyses that controlled for baseline depression, anxiety, and cynical

hostility analyses showed the indirect effect of physical activity still remained (β = -017; 95% CI = -.029, -.004) and the marginal indirect effect of smoking remained (β = -.012; 95% CI = -.031, 0.06). Further, the lack of an indirect effect through sleep quality (β = .001; 95% CI = -.005, .008) and cholesterol tests remained (β = .000; 95% CI = -.006, .006).

I explored a second alternate hypothesis and examined whether people with higher purpose in life might merely have higher baseline health. Two measures of health were used in this analysis. One was a sum of eight major chronic illnesses and the other was a 23-item measure of physical functioning. In analyses that controlled for baseline health, the results largely mirrored results from the previous alternate hypothesis. The indirect effect of physical activity remained (β = -.011; 95% CI = -.022, -.001) as well as the marginal indirect effect of smoking (β = -.016; 95% CI = -.036, .004). Further, the lack of an indirect effect through sleep quality (β = .005; 95% CI = -.005, .015) and cholesterol tests remained (β = .000; 95% CI = -.005, .005).

I explored a third and final hypothesis. Here I examined whether the associations found in the main hypothesis would remain after adjusting for baseline health behaviors. Adjusting for baseline health behaviors would attenuate these concerns. In analyses that controlled for baseline health behaviors there was still an indirect effect through physical activity (β = -.013; 95% CI = -.026, -.001). However, there was no longer an indirect effect of smoking (β = .000; 95% CI = -.011, .010). Further, the lack of an indirect effect through sleep quality (β = .005; 95% CI = -.005, .015) and cholesterol tests remained (β = -.002; 95% CI = -.010, .006).

Discussion

Overall Findings

A growing body of research has shown that purpose in life is longitudinally linked with health outcomes such as a reduced risk of myocardial infarction, stroke, Alzheimer's, and death (Boyle et al., 2010; Kim, Sun, Park, & Peterson, 2013; Kim, Sun, Park, Kubzansky, & Peterson, 2013). Most of these studies statistically adjusted for health behaviors and found that the associations between purpose in life and health were reduced, implying mediation. However, no study to date has directly tested if health behaviors mediate the relationship between purpose in life and health using structural equation modeling. Numerous researchers in the literature have urged investigators to examine the potential factors that might mediate the association between purpose in life and health outcomes—this is among the first papers to do so (Boehm & Kubzansky, 2012b; Pressman & Cohen, 2005; Ryff, 2014).

In a nationally representative sample of adults over the age of 51 who had no cardiovascular disease at baseline, analyses from structural equation models showed that physical activity and smoking mediated the association between baseline purpose in life and myocardial infarction over time, while sleep quality and use of cholesterol tests did not. Further, three alternate hypotheses were tested and the results attenuated concerns that baseline health, baseline health behaviors, or psychological ill-being were the true "active ingredients" that were driving the association between purpose in life and reduced risk of myocardial infarction.

Although positive psychological functioning (e.g., purpose in life) is not the mere absence of psychological ill-being (e.g., depression), psychological factors may work through the same behavioral mechanisms—although in the case of depression and purpose in life they likely exert opposing forces on behavioral mechanisms, where depression decreases physical activity and purpose in life increases physical activity. Results from the present study are in line with past research which has examined the behavioral mechanisms linking depression with

cardiovascular events. For example, researchers analyzed the REGARDS study, a large longitudinal study of 4,676 participants and they also found that out of several potential health behaviors, smoking and physical inactivity were the key behavioral mechanisms linking depression with myocardial infarction (Ye et al., 2013).

If these results are replicated in other samples and research groups, interventions that aim to increase purpose in life in order to enhance cardiovascular health should assess and examine physical activity and smoking as intermediate outcomes. These initial studies will likely be small in scale, with short follow-up times. Therefore, they may not be powered to detect differences in myocardial infarction outcomes between an intervention and non-intervention group. However, they will likely have enough power to detect changes in smoking and physical activity, two important factors that alter the risk of cardiovascular outcomes.

Limitations and Strength

This study had several limitations and strengths. This study relied on self-reported myocardial infarction information which could introduce bias. Although imperfect, high correlations between self-reported cardiovascular events and hospital records have been well documented—further self-reported data are particularly accurate for serious and acute events such as myocardial infarction, heart failure, and stroke. Despite the limitations of using self-reported myocardial infarction data, our findings are consistent with a substantial body of research demonstrating that purpose in life is linked with healthier physiological markers, healthier behaviors, and enhanced health outcomes (Roepke et al., 2013; Ryff, 2014). This tempers the probability that findings from this study are spurious or due to misclassification of the myocardial infarction outcome. Even so, future researchers should examine the associations

investigated in this study using objective cardiovascular measures that are available through administrative claims or medical records.

Future researchers should also use more precise measures of behavior such as accelerometers to monitor physical activity and polysomnography to monitor sleep quality. Further, due to data limitations this study was unable to examine how changes in purpose over time predict changes in health behaviors over time, which in turn predict risk of cardiovascular events. Although data to examine this question was not available, this type of analysis will become feasible with additional waves of data collection.

Finally researchers should examine the "dark side" of purpose in life. There is anecdotal evidence of people who are so engrossed in their purpose in life that they neglect health behaviors and other forms of self-care. Researchers should examine if such subgroups of people empirically exist. This type of information would be important if future purpose in life interventions are developed with the aim of health enhancement.

Despite these limitations, this study had several important strengths. It was the first study to examine the mediators between a positive psychological factor and health outcome using the structural equation modeling framework. This study also tested and ruled out important alternate hypotheses. Further, it used a large and nationally representative sample. In addition, a validated and widely used measure of the primary exposure of interest was available. Finally, the prospective nature of the HRS data minimized concerns that the relationships found in this study were due to reverse causality or retrospective reporting bias.

Conclusion

Cardiovascular disease is a leading cause of morbidity and death among older adults in the United States and the number of older adults is projected to double by 2050 (Vincent &

Velkoff, 2010). Continued research on purpose in life will not only increase our theoretical understanding of how mental and physical health interact, but continued research on purpose in life may also add to the development of novel and inexpensive cardiovascular prevention and intervention programs. If future research replicates our findings, researchers should consider examining whether purpose in life interventions lead to decreased smoking and increased physical activity, which in turn will lead to enhanced cardiovascular health. Past research attempting to improve cardiovascular outcomes by alleviating psychological ill-being (e.g., depression) has shown mixed results. Therefore, future researchers may want to consider adding interventions that enhance positive psychological functioning to existing intervention protocols that aim to improve cardiovascular outcomes by alleviating psychological ill-being.

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Table 5.1. Descriptive statistics (Baseline)*

Mean Purpose (SD)	4.59 (0.91)
Mean Age (SD)	67.53 (9.51)
Female	3,109 (59.77)
Race/Ethnicity	
European-American	4,030 (77.53)
African-American	676 (13.00)
Hispanic	418 (8.04)
Other	75 (1.44)
Married Status	3,441 (65.15)
Education	
< High School	896 (17.22)
High School	2,868 (55.13)
≥ College	1,438 (27.64)
Total Wealth	
1st Quintile	830 (15.96)
2nd Quintile	952 (18.30)
3rd Quintile	1,103 (21.20)
4th Quintile	1,134 (21.80)
5th Quintile	1,183 (22.74)
Mean Depression (SD)	1290 (1.84)
Mean Anxiety (SD)	1.54 (0.55)
Mean # of Chronic Illnesses (SD)	1.63 (1.17)
Mean Physical Functioning (SD)	3.30 (3.78)

*Unless otherwise noted, values are number of participants (percentage)

Table 5.2. Descriptive statistics (health behaviors)*

	2006	2008
Mean Sleep Quality (SD)	2.36 (1.02)	2.40 (0.93)
Current Smoker	695 (13.36)	563 (10.82)
Cholesterol Test Recipient	N/A	4,089 (84.17)
Physical Activity		
Never	841 (16.17)	839 (17.13)
1-4 times per month	1,145 (22.01)	1,207 (24.64)
More than 1x per week	3,215 (61.82)	2,852 (58.23)

*Unless otherwise noted, values are number of participants (percentage)

Table 5.3. Correlation coefficient of study variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Purpose	1.00							
(2)	Physical Activity	0.191	1.00						
(3)	Sleep Quality	0.193	0.163	1.00					
(4)	Cholesterol Test**	0.034	0.035	0.013	1.00				
(5)	Depression	-0.331	-0.205	-0.327	-0.016	1.00			
(6)	Anxiety	-0.325	-0.131	-0.216	-0.009	0.413	1.0		
(7)	Chronic Illnesses	-0.200	-0.203	-0.155	0.182	0.250	0.222	1.0	
(8)	Physical Functioning*	-0.291	-0.363	-0.252	0.000	0.422	0.290	0.402	1.0

*The coding of physical functioning is counter-intuitive. A higher value means a person has worse health because this variable is a count of physical functioning limitations

**Data on cholesterol tests was not collected in 2006, therefore this correlation is between 2006 purpose in life and 2008 cholesterol test data

Table 5.4. Change in health behaviors from baseline to follow-up

Smoking

- Smoking prevalence
    - 13% smoke in 2006
    - 10.75% smoke in 2008
- Change in smoking
    - 24% of people who smoke in 2006 stop smoking by 2008
    - 0.80% of people who don't smoke in 2006 start smoking in 2008

Physical activity

- Physical activity prevalence
    - 2006: no physical activity = 16%; low physical activity = 22%; moderate to high physical activity = 62%
    - 2008: no physical activity = 17%; low physical activity = 25%; moderate to high physical activity = 58%
- Change in physical activity
    - Of people who report no physical activity in 2006
        - 51% report no physical activity in 2008
        - 26% report low physical activity in 2008
        - 23% report moderate to high physical activity in 2008
    - Of people who report low physical activity in 2008
        - 20% report no physical activity in 2008
        - 41% report low physical activity in 2008
        - 39% report moderate to high physical activity in 2008
    - Of people who report moderate to high physical activity in 2006
        - 8% report no physical activity in 2008
        - 18% report low physical activity in 2008
        - 73% report moderate to high physical activity in 2008

Sleep ("how often do you feel really rested when you wake up in the morning?" – reverse coded)

- Sleep Quality
    - 2006: rarely or never = 14%; sometimes = 23%; most of the time = 63%
    - 2008: rarely or never = 10%; sometimes = 30%; most of the time = 60%
- Change in Sleep Quality

    - Of people who report rarely or never in 2006
        - 37% report rarely or never
        - 39% report sometimes
        - 23% report most of the time
    - Of people who report sometimes in 2006
        - 11% report rarely or never
        - 52% report sometimes
        - 38% report most of the time
    - Of people who report sometimes in 2006
        - 4% report rarely or never
        - 20% report sometimes
        - 76% report most of the time

Cholesterol test

- Cholesterol test prevalence
    - Information was not assessed in 2006
    - In 2008, 84.16% of respondents reported receiving cholesterol tests in the last two years

Table 5.5. Path models and tests of mediation

Paths	Beta (95% CI)
Purpose to Health Behaviors	
Purpose → Sleep Quality	.189 (.155, .222)
Purpose → Physical Activity	.203 (.160, .246)
Purpose → Smoking Status	-.114 (-.180, -.048)
Purpose → Cholesterol Test	-.025 (-.084, .034)
Health Behaviors To Myocardial Infarction	
Sleep Quality → Myocardial Infarction	-.004 (-.078, .070)
Physical Activity→ Myocardial Infarction	-.128 (-.205, -.051)
Smoking Status→ Myocardial Infarction	.125 (-.005, .256)
Cholesterol Test→ Myocardial Infarction	.082 (-.028, .193)
Tests of Mediation: Purpose → Health Behaviors → Myocardial Infarction	
Purpose → Sleep Quality → Myocardial Infarction	-.001 (-.015, .013)
Purpose → Physical Activity → Myocardial Infarction	-.026 (-.042, -.009)
Purpose → Smoking Status → Myocardial Infarction	-.016 (-.035, .004)
Purpose →Cholesterol Test → Myocardial Infarction	.003 (-.011, .006)

CHAPTER VI

Conclusion

In the last decade, a growing body of research has established a prospective association between baseline purpose in life and various health outcomes. This dissertation extended the existing literature by examining purpose in life in relation to risk of myocardial infarction using data from the Health and Retirement Study, a nationally representative sample of U.S. adults over the age of 51. Purpose in life was associated with a reduced risk of myocardial infarction and stroke over time. Further this dissertation examined potential mechanisms that might explain the association between purpose in life and myocardial infarction. It did so by examining purpose in life and use of preventive health care services over time. Purpose in life was associated with an increased use of cholesterol tests, cancer screenings (e.g., pap smears, mammograms, prostate exams), and colonoscopies. However purpose was not associated with receiving flu shots. This dissertation also used longitudinal data and a structural equation modeling framework to examine if four health behaviors mediated the association between purpose and myocardial infarction. Several researchers in the past have called for research that examines the mediators between positive psychological functioning and health outcomes and this is among the first studies to examine this question. The results from the study that examined mediators showed that physical activity and smoking mediated the association between purpose and myocardial infarction, but sleep quality and cholesterol testing did not.

Across all of the studies, findings remained even after adjusting for a range of possible confounders such as demographic factors and other covariates. Most importantly, the association between purpose in life and myocardial infarction and health behaviors remained after adjusting for different facets of psychological ill-being (e.g., depression, anxiety, cynical hostility). This finding helps attenuate concerns that the associations found in this dissertation were merely an artifact of a lack of psychological ill-being. These findings are in line with past research which demonstrate that purpose in life and other facets of positive psychological functioning (e.g., positive affect, life satisfaction, optimism) show a unique association with health and health behaviors even after adjusting for psychological ill-being (Boehm & Kubzansky, 2012; Pressman & Cohen, 2005; Ryff, 2014).

Purpose in Life Interventions: A Brief Overview

Several interventions have already been developed that can enhance purpose in life and related constructs. Mounting evidence suggests that these interventions can enhance behavioral and biological outcomes in lasting ways (Davidson & McEwen, 2012). For example, randomized controlled trials demonstrate that a meaning-centered therapy delivered in individual or group format can raise purpose and meaning among people with cancer (Breitbart et al., 2012; van der Spek et al., 2014). Another therapy, Well-Being Therapy, uses the cognitive behavioral framework and has been shown to help people suffering from an array of psychological disorders to achieve optimal levels of psychological well-being, including purpose in life (Ruini & Fava, 2012). Ryff (2014) reviewed over a dozen intervention studies that used various techniques (e.g., mediation, therapy) to enhance purpose in life and other related facets of psychological well-being. After further replication of results from this dissertation and further research into the

mechanisms that link purpose in life with health outcomes, future research should examine if purpose in life interventions enhance health behaviors and in turn enhance health outcomes.

Future Research Directions

The nature of and what constitutes a life high in purpose should be investigated. Although most researchers conceptualize purpose as emerging from within an individual, research has shown that relationships are often a core source of purpose (Debats, 1999; King, 2004). Therefore purpose may in large part be a product of interactions with others. How researchers conceptualize purpose (e.g., a construct that emerges from within an individual, from relationships, or a combination of both) is important because it will inform future interventions that are developed.

Future research should also tease apart how purpose in life precisely impacts our thoughts, behaviors, and individual actions. Does purpose in life impact only the large decisions in our lives such as having children, which career to pursue, which person to partner with? Or does purpose impact smaller daily decisions such as when and whether to bathe, eat, exercise, go to work or school? Or does purpose impact decisions that are so small, that we are not aware of making them? Purpose may help steer these decisions by helping people guide their use of finite personal resources.

Future research should also determine the psychological reasons why people with higher purpose may be more likely to engage in a wider array of health behaviors and use more preventive health services. As Frankl hypothesized, purpose may provide people a ‘why’ to live for, which then provides an individual a greater incentive to invest in his or her health.

Directionality is another issue that requires teasing apart. It is unclear if purpose causes better health and health behaviors or vice versa. There is likely a reciprocal process that requires data with several follow-up waves over a long period of time. Barbara Fredrickson's broaden and build theory may be a framework in which to view purpose and health behaviors (Fredrickson, 2001, 2004). Fredrickson and her colleagues have hypothesized and shown that positive affect interacts with various resources, which in turn causes an upward spiral of resources and health (Kok & Fredrickson, 2010; Kok et al., 2013). Another directionality issue is how behaviors might impact each other. For example, exercise may impact sleep quality and vice versa, however these reciprocal arrows were not tested in this dissertation due to data limitations. Future researchers who have more time points should examine these issues.

Future research should also examine where and how purpose in life overlaps (and does not overlap) with research on motivation, goals, values, hope, and future time orientation. Bridging these areas of research could lead to important advances in theory and intervention.

Finally, policy makers should carefully consider the implications of what it means to have increasingly larger numbers of older adults in a society, and how this demographic shift in the United States will impact several spheres of the United States. Although this careful and strategic thinking should consider several areas of society, policy makers should carefully consider how policies and government programs can help enhance purpose in life at the population level, as this construct appears to be a key ingredient that facilitates mental health, physical health, and quality of life.

Volunteering programs may be one possible route. Several volunteer programs, such as Experience Corp, Foster Grandparents, and the Retired and Senior Volunteer Program, have already been developed for the older adult population and help older adults transition into

purposeful and socially rich activities. These programs may create a win-win situation. Providing incredible value to society and also helping a portion of older adults either find or continue having meaning and purpose in their lives. Perhaps these volunteer programs can be supplemented with short paper and pencil interventions that have also been shown to increase purpose in life. Future studies should evaluate these programs and examine if they enhance levels of purpose in life, which may then translate into better health behaviors and health for the volunteers.

Final Thoughts

Considering our rapidly aging population, which will likely increase the number of people suffering from cardiovascular disease, continuing to research purpose in life and potential interventions may reveal an innovative way of simultaneously enhancing people's health behaviors and myocardial infarction which may then translate into lower health care costs. However more importantly these interventions would also enhance the quality of life among those moving into the ranks of our aging society.

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