Bridge Employment and Health

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Epidemiological Science)
in the University of Michigan
2016

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Acknowledgments

I would like to thank my advisor, Carlos Mendes de Leon for his strong leadership and mentoring as well as his academic support through the broad insights and care for details. I also would like to thank my other committee members for their time, expertise, and patience. I thank Mike Elliot, for always patiently guiding me through my statistical questions step by step, Jersey Liang, for his attention to help me not to miss the details, Bob Schoeni for his guidance for this project to the right direction, and Belinda Needham for her great sociological insights.

I also would like to thank the faculty, staff, and students at the Center for Social Epidemiology and Population Health for academic, technical, and administrative help. I thank Amanda Dudley for her endless technical and emotional support. Also, I am especially thankful to Lindsay Pull, Felice Le, Jonggyu Baek, and Jeff Wing for their statistical help and friendship which have given me courage and confidence throughout this process.

Also, I thank Jersey Liang, my advisor from the masters program, for initially letting me step into the world of epidemiology six years ago with his advice and support.

I would like to thank my parents for their overflowing love and support, and always being there for me. Special thanks to my husband, Do Yeon, for his caring support, patience, and understanding, as well as the excellent technical guidance through his excel expertise. You were with me from the very beginning of this journey and I am glad that I shared every moment of it with you. Lastly, I dedicate this dissertation to my daughter, Amelia Soobin Kim, the angel who made me the luckiest person in this world.

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List of Abbreviations

HRS	Body mass index
CES-D	Center for Epidemiologic Studies Depression scale
CI	Confidence interval
DAG	Directed acyclic graph
GEE	General estimating equation
HRS	Health and Retirement Study
IPW	Inverse probability weight
MSM	Marginal structural model
OR	Odds ratio
SD	Standard deviation
SE	Standard error
SES	Socioeconomic status

Abstract

Due to the increasing longevity, advancing yet skyrocketing health care costs, and the lack of funds for elderly welfare, post-retirement health among older adults has become a crucial issue both at the individual and societal level. Concurrently, with widespread implementation of pro-work policies and the notion of retirement as a gradual process rather than one-time transition, bridge employment rate in the US has increased continually for last few decades. However, little is known regarding how the two major societal trends are related. Determinants of bridge employment are not fully understood, and how bridge employment affects post-retirement health is largely unknown. In addition, there is little systematic information on gender difference in the precursors and consequences of bridge employment despite distinct occupational experiences and biological differences in men and women.

This dissertation focuses on the complex relationship between bridge employment and post-retirement health. Using data from Health and Retirement Study, a nationally representative longitudinal survey of individuals over age 50, major determinants of bridge employment among men and women were identified. Then, the effects of bridge employment on physical and mental health were investigated. Statistical analyses accounted for time-dependent confounders and potential bidirectional association in the relationship between bridge employment and health outcomes.

Via separate analyses for men and women, this study shows that men's bridge employment is often driven especially by his early-life socioeconomic status, rather than his high occupational ability or self-esteem in the work place, while women's bridge employment is

significantly influenced by her marital status, which may partly be due to women's nonlinear career trajectories. Bridge employment was associated with fewer depressive symptoms, while it was found to have deteriorative effects on physical functioning. Both associations did not differ by potential modifiers such as gender, income, education, and pre-retirement occupation.

By investigating the antecedents of bridge employment and examining its physical and mental health effects, this dissertation provides an insight on the mechanism of the non-traditional retirement process. Our findings may be useful for policy implications to improve well-being of a number of prospective retirees who may engage in bridge employment in the next few decades.

CHAPTER 1

Introduction

Background & Rationale

Bridge employment & pro-work policies

The concept of retirement nowadays has become increasingly multifaceted (M. Wang & Shultz, 2010). Retirement, which used to be a single event of permanent withdrawal from working life, has developed into an individualistic and sometimes prolonged transition process (Barnett, Van Sluijs, and Ogilvie 2012; Wang and Shultz 2010; Maestas 2010). Increasing number of retirees engage in bridge employment, which refers to "the pattern of labor force participation by older workers as they leave their career jobs and move toward complete labor force withdrawal" (Shultz, 2003; Cahill, Giandrea, Quinn, 2006). Indeed, about 53% of those leaving full-time career employment after age 55 moved to a bridge employment (Cahill et al., 2006). Also, about 45 percent of men and women reported to either be working or have worked on a bridge job (Cahill, Giandrea, Quinn, 2007).

Such phenomenon is largely due to a widespread implementation of pro-work policies to delay one's retirement age as well as to encourage a gradual retirement transition since the mid-1980s. To deal with the expected increase in the number of retirees, rise in health care bills for older population, and longer life expectancy, the government and many employers eliminated existing financial incentives for early retirement and made new incentives to have older Americans stay in labor force. The mandatory retirement age for most Americans was outlawed in 1986 via the extension of the Age Discrimination in Employment Act (ADEA) (Adams,

2004). Age-specific retirement incentives for Social Security were eliminated, and its normal retirement age for receiving full retirement benefits was raised by 2 months per year for baby boomer generation (to age 67 by 2022) (Clarke, Marshall, Weir, 2012). Removal of Social Security earnings tests for Social Security beneficiaries who have reached full retirement age enabled older adults to either stay in the labor force longer or to return to the labor force post-retirement. In terms of the pension policy, defined contribution (DC) pension, where employees are not provided with early retirement incentives and bear all the investment risk of retirement assets, has been rapidly replacing defined benefit (DB) plans, which typically contain strong early retirement incentives and has employers bear the investment risk of retirement assets (Cahill et al., 2007).

As a result, more retirees are in need of financial means without the incentives that used to be available post-retirement, yet to some extent, older adults are protected by the government against age discrimination in the workplace. Both those in need of financial means and those who enjoy working and want to work even in their older age are by law eligible to get involved in labor force and are not disadvantaged because of their age. Such policies, together with the prosperous economy and low unemployment rate of the late 1900s (Cahill et al., 2007), encouraged the changes in the retirement environment where an increasing number of workers with full time career jobs move to bridge job employment instead of choosing permanent exit from the labor force. For many, retirement has become a "process" of multiple transitions over one's older years, rather than a simple transition from a working state to a non-working one (Wang, Zhan, Liu, Shultz, 2008).

In fact, there are various avenues to retirement: partial retirement involves a change in employer and usually reduction in hours, while phased retirement involves reduced hours with

one's current employer (Kevin E Cahill, Giandrea, & Quinn, 2015a). Unretirement refers to a reentry to the working state when an individual leaves the labor force but then later reverse course and reenters (Kevin E Cahill et al., 2015a). Bridge employment, one's employment after retirement from full-time career job, is one of many avenues of retirement as a result of the changing retirement income landscape due to pro-work policies, in addition to other factors such as age, health status, and marital status. To our knowledge, whether or not the determinants of each of the avenues differ is not yet investigated. The definitions of BE, phased retirement, and unretirement may overlap with one another, and all of those avenues may be collectively called as post-retirement employment (Beehr & Bennett, 2015; Kevin E Cahill et al., 2015a). In this study, bridge employment is distinct from phased retirement, which work for the same employer after retirement; yet BE may have some overlap with unretirement – reversing the retirement and resuming to work years after retirement, since BE includes all the post-retirement employment as long as it is for a different employer.

Increasing number of older Americans are expected to be seeking bridge employment in the future labor environment (Beehr & Bennett, 2015). Understanding how and why older adults may remain working later in life is the key for the government and employers to utilize the rich resource of experienced workers who are willing to work beyond career employment. Aim1 of this dissertation, therefore, attempts to identify important determinants of bridge employment.

Post-retirement health & bridge employment

Post-retirement health among older adults has become a crucial issue both at the individual and societal level. Skyrocketing health care costs with rapidly advancing medicine has led to the longer number of years in retirement for most retirees, yet at the same time, severe burden for government funds for elderly welfare such as health insurance and social security

benefits for retirees. Also, unhealthy post-retirement years may not only decrease retirees' life satisfaction but also load a physical, psychological, and financial burden for family members and other care givers.

Depression is one of the most representative and devastating mental health disorders in late life due to its dire consequences (Aziz & Steffens, 2013). About 4 percent of community-living older adults 65 years and older (1.2 – 1.8 million) in the US have current depressive disorder, and about 12 percent of elderly population suffer from depression in the hospital and long-term-care settings (Aziz & Steffens, 2013). Depression is associated with increased risk of morbidity, increased risk of suicide, decreased physical, cognitive and social functioning, greater self-neglect, increased cardiac and cerebrovascular disease, and increased neurological conditions, all of which are in turn associated with increased mortality (Blazer, 2003; Fiske et al., 2009; Schulz et al., 2000). Moreover, geriatric depression is costly; total health care costs were 47-51% higher for depressed elders than non-depressed patients, even after adjustment for chronic medical illness (Katon, Lin, Russo, & Unutzer, 2003).

On the other hand, age-related functional limitation and disability is one of the common conditions of aging. Functional limitation refers to the loss of ability to perform tasks and obligations of usual roles and normal daily life, while disability is one's pattern of behavior which evolves with the functional limitation (Kelly-Hayes, Jette, Wolf, D'Agostino, & Odell, 1992). Due to a number of comorbidities and dire outcomes, functional limitation and disability impose a heavy burden on individual older adults as well as our society. Loss of physical function and dependence on assistance in performing activities of daily living (ADLs) require hospitalization and extended hospital stays, which in turn, cause involuntary weight or muscle strength loss as well as low physical activity (Chou, Hwang, & Wu, 2012). Such consequences

of functional loss may further cause poor quality of life and eventually lead to reduced longevity (Chou, Hwang, and Wu 2012; Reid & Fielding, 2012; Villareal et al. 2011). Furthermore, older persons who were functionally dependent accounted for 46% of the healthcare expenditures, but only made up 20% of the older adult population (Fried, Bradley, Williams, & Tinetti, 2001). Additionally, they spent $5000 more per year than people who remained independent (Pahor et al., 2014; G. Wang, Pratt, Macera, Zheng, & Heath, 2004).

Due to its numerous comorbid chronic conditions which altogether destroy elderly health, depression and physical function disability in late life are urgent public health issues which should be addressed clinically as well as politically to postpone their onset and reduce the prevalence. Investigating the association of bridge employment with depression and physical functioning in older adults provides an insight on how the future labor policies and diversifying retirement processes among older adults may influence retirees' mental and physical health, which may also have useful policy implications. Thus, Aim2 and Aim3 of this dissertation focus on the health consequences of BE.

Previous Literature on Retirement, Bridge Employment, and Health

Determinants of bridge employment

A number of variables have been identified as factors of bridge employment. Studies have found that financial pressure and good health are two most important predictors for participating in bridge employment (Wang et al.,2008; Reynolds, Ridley, Van Horn, 2005). Financial pressure may force retirees to work post-retirement, while good health status may provide physical capacity to engage in bridge employment. Other studies have found that post-retirement employment is associated with good health, high levels of education, having two or more children, male gender, younger age, and being wealthy (Moen, Kim, Hofmeister,2001;

Clark & Ogawa,1997; Kim & Feldman,2000). Married older women are less likely than unmarried women or men of any marital status to continue to work or reenter labor market after retirement (Pleau,2009; Choi,2001). High earnings were found to be associated with greater odds of postretirement employment for women but lower odds for men (Pleau,2009). Some found that both higher and lower ends of wage distribution had higher rates of bridge employment than did those in the middle, highlighting the difference between those who chose to engage in bridge employment voluntarily and those who had to work out of financial necessity (Cahill et al., 2007).

Despite such findings, the knowledge on the factors of bridge employment is still incomplete due to the limitations on the use of comprehensive longitudinal data and proper methodological analysis. Many applied cross sectional analysis to examine prevalence of bridge employment as the outcome, and others used only limited number of waves of longitudinal data. There is no study to our knowledge which identified the determinants of BE via separate analyses by gender, accounting for fundamental gender differences throughout one's life course.

This dissertation aims to enhance the understanding of why and how Americans work after retirement by identifying major determinants of BE in men and women separately. The gender-stratified analyses were motivated by the theoretical frameworks suggesting distinct social patterns leading to BE in men and women which may result in different determinants of BE and health consequences of BE by gender. However, at the same time, our gender-specific analyses may not be directly comparable for men and women and therefore preclude definitive statements on the statistical robustness of gender differences in the determinants of BE and health consequences of BE.

Retirement Effects on Depressive Symptoms

While late-life depression is observed in one's post-retirement years, retirement itself was found to have little negative effect on depression. Most studies that have looked at retirement effects on mental health showed that retirement has positive impact on mental health (Johnston & Lee, 2009; Insler, 2014; Mein, Martikainen, Hemingway, Stansfeld, & Marmot, 2003; Salokangas & Joukamaa, 1991). A Kaiser Permanente study found that retirement was associated with less stress (Midanik, Soghikian, Ransom, & Tekawa, 1995). More specifically, a recent study by Jokela et al. found that voluntary early retirement and statutory retirement were found to be associated with better mental health (Jokela et al., 2010)

Retirement Effects on Physical Functioning

A number of recent studies have looked at the association between retirement and physical functioning, all of which found deteriorative retirement effects on physical functioning. Stenholm et al. found that physical functioning declines faster in retirement than in full-time work in employees aged 65 years or older, and that this association was not explained by absence of chronic diseases and lifestyle related risks (Stenholm et al., 2014). Another study found that the complete retirement leads to 5-16 percent increase in difficulties associated with mobility and daily activities (Dave, Rashad, & Spasojevic, 2008). Some studies suggests that retirement introduces a reduction in physical activity and explained this association between retirement and physical function decline by reduced physical activity following retirement (Chung, Domino, Stearns, & Popkin, 2009; Slingerland et al., 2007). Lastly, involuntary retirement was associated with negative health consequences; a study using the Health and Retirement Study (HRS) found poorer physical functioning for workers who experience involuntary job loss (Gallo, Bradley, Siegel, & Kasl, 2000).

Bridge Employment & Health

Despite the increasing trend of bridge employment, there exists little systematic knowledge on its mental and physical health consequences. Studies examining the consequences of bridge employment have largely focused on outcomes such as retirement adjustment and life satisfaction, which were found to be beneficial (Calvo, Haverstick, & Sass, 2009; Choi, 2001; Kim & Feldman, 2000). However, specific mental and physical health outcomes have been mostly neglected by researchers. Only one study explicitly explored the effects of bridge employment on post-retirement health using a longitudinal set of data. Zhan, Wang, and Liu, in their 2009 study, used the first 4 waves of HRS to examine the relationship between bridge employment and retirees' health outcomes including depression and physical functioning. They found that bridge employment related to one's pre-retirement career field was associated with less depressive symptoms and bridge employment either in a career field or in a different field was associated with fewer functional limitations compared to not engaging in bridge employment (Zhan et al., 2009).

While very little is known about the health consequences of bridge employment, this dissertation aims to complement the current research gap by investigating the effects of bridge employment on depressive symptoms and physical functioning among older adults in Aim2 and Aim3. We attempt to broaden the current knowledge on this topic by investigating potential social mechanisms of how BE benefits or deteriorates mental and functional health. In addition to simply testing BE effects on health, we test if socioeconomic status, extended family relationships, and occupational categories modify this association. While there is no other study so far which has explored the mechanisms of the health consequences of BE, our study may be the stepping stone for future research to investigate such pathways which connect diverse retirement processes and post-retirement mental and physical health.

Theoretical Background

In this dissertation, social role theory (Eagly & Steffen, n.d.) and continuity theory (Atchley, 1989) are used as general frameworks for investigating determinants of bridge employment and understanding the health effects of bridge employment. Social role theory, which was used in Aim 1 and Aim 2 emphasizes socially designated gender roles which may affect individual behaviors. It is used to explain different determinants of bridge employment in men and women in Aim 1 and is applied to the potential mechanism of how gender-related covariates may modify the bridge employment effects on health in men and women. Continuity theory, used in Aim 2 and Aim 3 to predict health consequences of bridge employment, highlights the aspect of retirement adjustment; it suggests older adults adapt to change by keeping a consistent life pattern after retirement, which may preserve their health.

From social roles perspective, low-SES men and high-SES men may be more likely to obtain bridge employment than middle-SES men; low-SES men may seek BE to fulfill financial necessity of his household, while high-SES men may engage in BE to enjoy their roles as competent breadwinners. Men at the both ends of social spectrum, however, may obtain social approval and self-satisfaction by behaving according to the gender obligation of being a breadwinner for their families. Moreover, married men may modify these associations. Low-SES married men may be more likely to engage in bridge employment than low-SES unmarried men since married men has more family members to provide with; high-SES married men may be more likely to engage in BE than high-SES unmarried men, because they may obtain more satisfaction and social approval from his family members if they are married. On the other hand, low SES women are more likely to engage in BE than high-SES women due to the social structure which may have driven them to have discontinuous occupational trajectories, which

may have led them in need of more financial resources. Women with many extended family relationships may have more caregiving obligations and may be less likely to engage in bridge employment than women with few extended family relationships. These associations in women may be stronger among married women than in unmarried women, since the traditional gender obligations for women tend to increase with marriage.

In terms of health consequences of bridge employment, men would have more beneficial mental health consequences from bridge employment than women would. Men's bridge employment is a means to continue stereotypic gender obligations by providing financial support for his family. On the other hand, women's bridge employment may be considered as an additional burden on top of their traditional gender roles which may be stressful. Similarly, having many children and living parents may provide men with opportunities to serve as the breadwinner and get approved by the family members, which may give them satisfaction and improve their mental health. Yet women with many children and living parents may have more domestic obligations on top of bridge employment which may be stressful and decrease the benefit from bridge employment on mental health.

Continuity theory suggests that those who engage in bridge employment will have better health status than those who are fully retired, since the bridge employment is a means to sustain the pre-retirement lifestyle. By preserving the pre-retirement lifestyle after retirement, one can experience retirement transition smoothly and satisfactorily, which may benefit one's mental health, and eventually, physical health as well. These associations may vary in terms of the motivation of the desire for continuity. Those of low SES would have less health benefit from BE than those of high SES; those of low SES may desire for continuity to sustain their financial stability, while those of high SES may desire for continuity out of pure enjoyment of their work

as well as the fear of losing their work role. Since the financial strain is associated with depression, low SES retirees may have decreased benefits of bridge employment on health due to their stress from post-retirement financial strain.

Data Source & Study Population

The Health and Retirement Study (HRS) is a nationally representative biennial longitudinal survey including more than 37,000 individuals in the US over age 50 (Juster & Suzman, 1995; Sonnega et al., 2014). A major goal of the HRS is to explore the role of health in the retirement decision and the long term health consequences of the retirement process (Wallace & Herzog, 1995). For the purpose of this dissertation, RAND HRS data set (version N) prepared by the RAND Center for the Study of Aging with support from Social Security Administration (SSA) and National Institute of Aging (NIA) was used.

The HRS core cohort was used in all chapters of this dissertation for two important reasons. First, born between 1931 and 1941, they are relatively recent cohort with the most extensive longitudinal data and an increasing bridge employment rate. Their retirement processes have just started to be influenced by the recent pro-work government and employer policy changes. Second, HRS core women have started to become well-educated and delimit themselves from the traditional role of housewives. Investigating the factors of bridge employment and its effects on post-retirement health at the transition of retirement environment as well as the beginning of the increase in women's career participation provides a crucial landmark to predict and prepare for the future baby boomers' retirement process at individual and societal level.

Analytical Approach

The goal of Aim 1 is to determine primary determinants of bridge employment. We tested the degree to which primary determinants predict the likelihood of engaging in bridge employment at any point during the eleven waves of follow-up. To account for correlated data structure due to repeated assessment of individuals, a logistic model was performed using weighted Generalized Estimating Equation (GEE) (Liang & Zeger, 1986), adjusting for sampling weight for each wave.

Aim2 and Aim3 of this dissertation investigate the effects of bridge employment on mental and physical health. Since time-varying covariates in this association behave as confounders as well as mediators, we use marginal structural models (MSMs) to minimize bias. Moreover, MSMs control for potential bidirectional relationship between bridge employment and health outcome as well. All analyses were conducted using the SURVEY procedures in SAS software (version 9.3) to account for clustering and the differential probabilities of sampling in the HRS.

Aims & Hypotheses

The purpose of this dissertation is to investigate the determinants of bridge employment and examine its health consequences in men and women using a nationally representative HRS sample. The conceptual diagram in Figure 1.1 represents the hypothesized pathways of bridge employment leading to health consequences. The knowledge of who engages in bridge employment and how bridge employment influences health in specific populations may be useful to improve individual health as well as cost-effective policy making for the government. The specific aims and hypotheses addressed in this dissertation are as follows:

Aim 1

Identify determinants of bridge employment among men and women

Aim 1-M

Identify determinants of bridge employment among men

Hypotheses1-M

Among men,

1-Ma. Both lower and higher ends of financial means are associated with a higher likelihood of bridge employment; financial means have a curvilinear association with bridge employment.

1-Mb. Education has a positive association with bridge employment; white collar or high-skilled pre-retirement occupations are associated with a higher likelihood of bridge employment than blue collar or low-skilled pre-retirement occupations are.

1-Mc. Being married further increases the effect of financial means, education, and pre-retirement occupations on bridge employment.

Aim 1-F

Identify determinants of bridge employment among women

Hypotheses 1-F

Among women,

1-Fa. Lower financial means is associated with a higher likelihood of bridge employment.

1-Fb. Having more extended family relationships is associated with a lower likelihood of bridge employment.

1-Fc. Being married further decreases the likelihood of bridge employment both for those of lower financial means and those who have more family relationships.

Aim 2-1

Investigate the association between bridge employment and depression

Hypotheses 2-1

Engaging in bridge employment on average is associated with fewer depressive symptoms.

Aim 2-2

Investigate if gender modifies the association between bridge employment and depression

Hypotheses 2-2

The beneficial effect of bridge employment on depressive symptoms is stronger among men than among women.

Aim 2-3

Investigate if income and education modifies the association between bridge employment and depression

Hypothesis 2-3

High income and high education on average increase the beneficial effect of bridge employment on depressive symptoms.

Aim 2-4

Investigate if family relationships modify the association of bridge employment with depression.

Hypothesis 2-4

Having more extended family relationships on average increases the beneficial effect of bridge employment on depressive symptoms among men, while decreases the beneficial effect among women.

Aim 3-1

Investigate the association between bridge employment and physical functioning

Hypothesis 3-1

Bridge employment is associated with fewer physical functioning disabilities.

Aim 3-2

Investigate if pre-retirement occupation modifies the association between bridge employment and physical functioning

Hypothesis 3-2

White collar or sedentary pre-retirement occupations, compared to blue collar or physically demanding occupations, are associated with less beneficial effect of bridge employment on physical functioning.

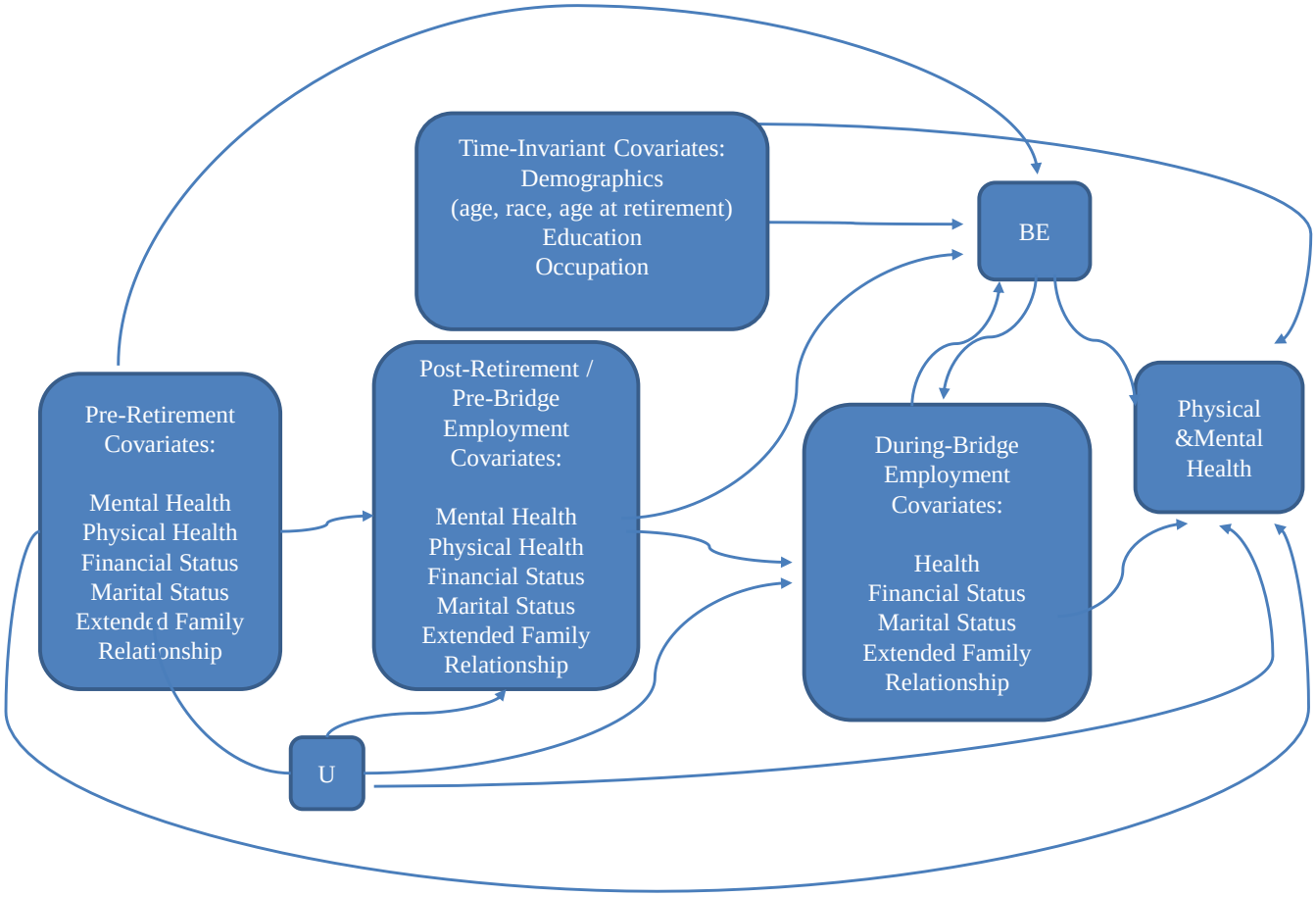
Aim 3-3

Investigate if income and education modifies the association between bridge employment and physical functioning

Hypothesis 3-3

High education and high income increase the beneficial effect of bridge employment on physical functioning.

Figure 1.1 Conceptual Diagram: Relationships between Major Determinants of Bridge Employment, Bridge Employment, and Post-Retirement Mental and Physical Health in Men and Women



CHAPTER 2

Determinants of Bridge Employment in Men and Women

Background

A large portion of older Americans today takes a more complicated exit from work-life rather than a simple retirement during which no further gainful employment is pursued. Only about half of all workers go through a traditional retirement experience by abruptly ceasing all paid work in pursuit of a life of leisure and hobbies (Beehr & Bennett, 2015; Maestas, 2010; R. L. Pleau, 2010; R. Pleau & Shauman, 2013). An increasing number of retirees continue or resume economically productive activity after retirement by engaging in some form of paid employment, which is known as "bridge employment" (Beehr & Bennett, 2015; Sargent, Lee, Martin, & Zikic, 2013; M. Wang & Shultz, 2010). Bridge employment is defined as "a workforce participation process between one's retirement decision and entering full retirement" (M. Wang & Shultz, 2010). As a growing number of retirees engage in bridge employment, it may become the "new normal" for (Beehr & Bennett, 2015; Maestas, 2010; R. L. Pleau, 2010; M. Wang & Shultz, 2010; Zhan et al., n.d.; Zhan, Wang, Liu, & Shultz, 2009). Yet, how and why older Americans choose to resume working after retirement is not fully established. In addition, despite the fundamental differences in career trajectories and socially expected gender roles for men and women, there is little empirical knowledge regarding gender differences in determinants of bridge employment.

Bridge employment & pro-work policies

Secular trends towards increased bridge employment are largely due to a widespread implementation since the mid-1980s of pro-work policies to increase one's retirement age and encourage a gradual retirement transition. To deal with the expected increase in the number of retirees, the rise in health care costs for the older population and longer life expectancy, the government and many employers have eliminated existing financial incentives for early retirement and created new incentives to have older Americans stay in the labor force. For example, the mandatory retirement age for most Americans was outlawed in 1986 via the extension of the Age Discrimination in Employment Act (ADEA) (McNamara, Sano, & Williamson, 2012; von Schrader & Nazarov, 2015). Age-specific retirement incentives for Social Security were eliminated, and the retirement age for receiving full Social Security benefits was raised by 2 months per year for the baby boomer generation (to age 67 by 2022) (Clarke, Marshall, & Weir, 2012). Removal of earnings tests for Social Security beneficiaries who have reached full retirement age has enabled older adults to either stay in the labor force longer or to return to the labor force post-retirement. In terms of pension policy, defined contribution (DC) plans, where employees are not provided with early retirement incentives and bear all the investment risk of retirement assets, have been rapidly replacing defined benefit (DB) plans, which typically contain strong early retirement incentives and has employers bear the investment risk of retirement assets (Cahill, Giandrea, & Quinn, 2015; Cahill, Giandrea, & Quinn, 2005).

With the major changes in pension policy and elimination of various incentives that used to be available post-retirement, more retirees are in need of additional financial resources. Additionally, older adults are protected against age discrimination in the workplace via pro-work policies implemented by the government. In other words, both those in need of financial resources and those who enjoy working and want to work in older age are by law eligible to

participate in the labor force and are not disadvantaged because of their age. Such policies, together with the prosperous economy and low unemployment rate of the late 1980's and 1990's have encouraged changes in the retirement environment where an increasing number of workers with full time career jobs move to bridge job employment instead of choosing a permanent exit from the labor force (Kevin E Cahill et al., 2015b). Bridge employment has redefined retirement as a "process" of multiple transitions over one's older years, rather than a simple transition from a working state to a non-working one (Mo Wang, Zhan, Liu, & Shultz, 2008).

Empirical evidence – Determinants of bridge employment

A number of characteristics have been identified as determinants of bridge employment. Studies have found that financial pressure and good health are the two most consistent predictors of bridge employment (Kim & Feldman, 2000; R. L. Pleau, 2010; Mo Wang et al., n.d.). Financial pressure may force retirees to work post-retirement, while good health status may provide physical capacity to engage in bridge employment. Other studies have found that post-retirement employment is associated with good health, high levels of education, having two or more children, male gender, younger age, and being wealthy (Clark & Ogawa, 1997; Kim & Feldman, 2000; Phyllis Moen, Kim, & Hofmeister, 2001a). Married older women are less likely than unmarried women or men of any marital status to continue to work or reenter the labor market after retirement (Choi, 2001; Pleau, 2010). In another study, high earnings were found to be associated with higher levels of post-retirement employment for women but lower levels for men (Pleau, 2010). Finally, both the higher and lower ends of the wage distribution have been related to higher rates of bridge employment, suggesting differential motivations to seek bridge

employment for those who do so for the rewards that come from gainful employment, and for those for whom this may be a financial necessity (Cahill, Giandrea, & Quinn, 2006).

While these findings provide an initial understanding of the determinants of bridge employment, their validity remains somewhat uncertain, due to the lack of rigorous prospective information derived from nationally representative study populations. While some previous studies have used nationally representative samples, this work has been limited to either cross-sectional analyses or short-term follow-up periods (K. E. Cahill et al., 2006; Clark & Ogawa, 1997; Kim & Feldman, 2000; R. L. Pleau, 2010). In addition, previous studies have largely failed to attend to the potentially important gender differences in the determinants of bridge employment. Only one study explored gender differences in bridge employment, although no gender-specific hypotheses were tested, or gender-specific analyses were performed. Separate analyses for men and women are required to account for the fundamental gender differences in retirement processes, distinct career trajectories, and social roles over the life course. Our study is the only study that uses longitudinal analysis with nationally representative data, while also addressing the gap of fundamental gender differences in bridge employment.

Understanding why and how older Americans choose to remain working later in life is the key for government and employers to utilize rich pool of experienced workers who are willing to work beyond career employment. This study aims to enhance such understanding beyond the existing knowledge by identifying major determinants of BE in men and women separately. While our gender-specific analyses may not be directly comparable, the potential gender differences in the antecedents of BE may imply distinct motivations and social mechanisms of working after retirement in men and women. Though further studies may be necessary for policy implications, this study may serve as the first step to holistic research of

diverse retirement processes where we consider both social environment and individual life course together.

Theoretical background

We use social role theory as a theoretical framework in identifying major determinants of bridge employment in men and women. According to social role theory, social, structural, and cultural factors which engender sexual division of labor and gender hierarchy are the root cause of differences in behavior of men and women (Eagly & Steffen, n.d.). Our social structure divides men and women in terms of labor, occupational roles, and hierarchical status. Men are more likely than women to occupy wage labor as opposed to domestic labor, to work in occupations requiring dominant and assertive qualities as opposed to nurturing and caring qualities, and to occupy high-status as opposed to low-status roles (Cejka & Eagly, 1999; Eagly, Wood, & Diekman, 2000; Eagly & Steffen,1984; Eckes & Trautner, 2000). These stereotypic gender roles coexist with other roles based on factors such as family relationships and occupation, and affect individual behaviors in social interaction. During social interactions, individuals strive to take gender roles into account as they try to reach important goals, enhance their self-esteem and gain approval from others. Specifically, people expect rewards of social approval and cooperation by meeting others' expectations about socially designated male and female behavior in social interactions. Also, living up to one's own personal expectations about gender-appropriate behavior can yield self-esteem and self-satisfaction (Eagly et al., 2000).

Despite the ongoing shift in gender roles in social structure as more than the majority of women in the US now work outside home, traditional gender expectations have not entirely disappeared. Men still take major responsibility for providing financially for their families in general (Cejka & Eagly, 1999; Riggs, 1997). Although most women in the US are employed in

the paid workforce, they have lower wages than men, are concentrated in different occupations, and are rarely at the highest levels of organizational hierarchies (Gayle, Golan, & Miller, 2012; Penner, Toro-Tulla, & Huffman, 2012; Reid, 1998). Moreover, men's career opportunities are more rigidly structured by chronological age (Settersten & Hagestad, 1996), while women's occupational trajectories are often more unpredictable and discontinuous than those of men. This is due in large part to the fact that women's work decisions are shaped directly by family demands such as childbearing and caregiving for children and elderly (Moen, Robison, & Fields, 1994; Phyllis Moen, Kim, & Hofmeister, 2001; R. L. Pleau, 2010; Settersten & Hagestad, 1996). Thus, women of recent generations have been under the double burden of fulfilling the traditional gender role of a family caregiver and a formal occupational career.

Separate determinants of bridge employment in men and women

While pro-work policy initiatives triggered transformation of the political environment to encourage gradual retirement of older adults, individual efforts to conform to the expectations of traditional gender stereotypes in social interactions may mediate the influence of policy on post-retirement decisions. From a social role perspective, different factors may influence bridge employment in older men and women when their distinct career trajectories and gender roles throughout the life course are considered. Therefore, this paper attempts to identify important determinants of bridge employment among men and women separately.

Men with low financial means tend to have few savings and low post-retirement income, and thus are likely to take advantage of the pro-work policies and seek bridge employment. They may work post-retirement to meet socially designated male role and take more responsibility for providing financially for himself and his family. Men with greater financial means, higher education, and skilled pre-retirement occupation would have a high likelihood of engaging in

bridge employment as well, because social approval and self-satisfaction derived from occupying high status in the organizational hierarchy and serving as a competent breadwinner for himself and his family may motivate them to continue working after retirement (Eckes & Trautner, 2000b). Marital status may modify the association of bridge employment with financial status, education levels, and pre-retirement occupations. From a perspective of social role theory, married men have more responsibility as a main financial provider for his family than those who are divorced, widowed, or never married. Therefore, married men with fewer financial resources would be more likely to engage in bridge employment than unmarried men. Married men may also feel more satisfaction from successfully carrying out the stereotypical male role for his family than unmarried men; thus, highly educated married men with white-collar or skilled pre-retirement occupations would be more likely to engage in bridge employment than their unmarried counterparts.

For women, those with low financial means are more likely to have bridge employment than those who are financially more secure. From a social roles perspective, many low-income women tend to have little savings as well as limited insurance and pension benefits because of their discontinuous occupational trajectories shaped by childbearing and caregiving roles throughout their life course. (Moen et al., 1994; Pleau, 2010; Settersten & Hagestad, 1996). Many women have part-time jobs at some point of their career or stop working for several years to fulfill the female traditional role of caregiving and homemaking (Pleau, 2010; Settersten & Hagestad, 1996). Also, women with extended family relationships would have more demands for traditional caregiving for their husbands, parents, children, and/or grandchildren, and thus, are less likely to engage in bridge employment after retiring from their career job. Marital status may modify the association between bridge employment and its determinants in women. Among low-

income women, those who are married are less likely to have bridge job than those who are unmarried as married women can rely on their husband's financial means. Married women are also expected to face more social pressure to fulfill the stereotypical gender role such as caregiving for family members; thus, the negative effects of extended family relationships on bridge employment would be stronger among the married than the unmarried women.

Aims and Hypotheses

These separate expectations on determinants of bridge employment in men and women based on the social roles perspective lead to our aims and hypotheses below:

Aim 1-M

Identify determinants of bridge employment among men

Hypotheses1-M

Among men,

1-Ma. Both lower and higher ends of financial means are associated with a higher likelihood of bridge employment; financial means have a curvilinear association with bridge employment.

1-Mb. Education has a positive association with bridge employment; white collar or high-skilled pre-retirement occupations are associated with a higher likelihood of bridge employment than blue collar or low-skilled pre-retirement occupations are.

1-Mc. Being married further increases the effect of financial means, education, and pre-retirement occupations on bridge employment.

Aim 1-F

Identify determinants of bridge employment among women

Hypotheses 1-F

Among women,

1-Fa. Lower financial means is associated with a higher likelihood of bridge employment.

1-Fb. Having more extended family relationships is associated with a lower likelihood of bridge employment.

1-Fc. Being married further decreases the likelihood of bridge employment both for those of lower financial means and those who have more family relationships.

Methods

Data source: Health and Retirement Study (HRS)

The Health and Retirement Study (HRS) is a longitudinal household survey data set for the study of retirement and health among the elderly in the United States. The details of this cohort have been described elsewhere (Juster & Suzman, 1995). In short, HRS is a panel study conducted biennially since 1992 for Americans age 50 and over, and includes data for health, wealth, income, pension, health insurance, family structure, retirement expectations, and employment history (Gustman, Mitchell, & Steinmeier, 1995). HRS includes eligible spouses as respondents and oversamples blacks, Hispanics, and residents of Florida (Juster & Suzman, 1995). We used the RAND HRS data files (version N) which were prepared by the RAND Center for the Study of Aging with support from Social Security Administration (SSA) and National Institute of Aging (NIA).

Eligibility criteria

Figure 2.1 describes the eligibility criteria for the purposes of this study. The analyses for this study center on retirees in one cohort of HRS respondents known as the "HRS core" (born 1931-1941) who were interviewed biennially from 1992 (age 51-61) to 2010 (age 69-79). The total size of the HRS core cohort classified by birth year is n=10,490, including 4,976 males and 5,514 females.

We specifically focused on those employed at the first survey and eligible to go through retirement process to take a fully prospective approach. We excluded those who are retired at baseline, and thereby avoided inclusion of those who retired years prior to the first survey. Only participants who reported working and were not retired at wave 1 were included (n=5,904 (3,010 males and 2,894 females)).

Participants, who reported working full-time and part-time at wave 1, were followed from wave 2 to wave 11 to identify the time of retirement. Once a person retires, he or she becomes eligible for our analyses. Only those who were completely or partly retired between waves 2 and 11 and who reported the year of retirement were included, because bridge employment by definition is a career pattern among those who retire from their career jobs (n= 4,474 (2,249 males and 2,225 females)). We further excluded those whose longest tenured occupation was the military (n=6) since military careers are unique in their patterns of retirement. The final sample yielded n=4,468, including 2,243 males and 2,225 females.

Outcome Variable: Bridge Employment

The outcome of interest for Aim1 is bridge employment (see Figure 2.2). For the purpose of this study, we followed previous literature to define bridge employment as "employment following a full-time career job," (Adams & Beehr, 2003; Beehr & Bennett, 2015; Cahill et al., 2006) with other specifications. Bridge employment could be self-employment, temporary employment, part-time or full-time job, and should be less than 10 years of duration if it was a full-time job (Feldman, 1994). Bridge employment in this study excluded work for the same employer as one's long-term employer and is distinguished from "phased retirement," which means gradual reduction of work with a long-term employer as an older employee approaches full retirement (Cahill et al., 2006; Chen & Scott, 2006). We defined bridge employment as

participation in the labor force for less than 10 years for an employer different from his or her career, after declaring retirement from one's career employment, regardless of the length of time an individual is out of the labor force after retirement. Out of 2,243 men and 2,225 women eligible for our study, 934 men (42%) and 746 women (34%) who engage in bridge employment were identified.

Primary predictor variables

Financial means

Total household income was used as a measure of financial means. It was the sum of all income in a household, which included the respondent's and spouse's individual earnings, employer pension or annuity, Social Security income, individual unemployment or workers compensation, food stamps, household capital income as well as alimony, insurance, and inheritance. Total income was log-transformed and centered at the median value, and included as a time-varying, continuous variable. In addition to total household income, individual wealth was originally included (not shown), but was not associated with bridge employment in both men and women, and therefore, was not included in any of our models.

Pre-retirement occupation

Pre-retirement occupation was first categorized into five categories – white collar, skilled service, unskilled service, blue collar, and military. After military occupation was omitted due to its unique pattern of retirement (Pleau 2010), we used a binary pre-retirement occupation categorized into white collar/high-skilled service occupations and blue-collar/low-skilled service occupations. The specific classification based on the HRS coding of occupation from the 2000 Standard Occupational Codes (SOCs) is shown in Figure 2.3.

Education

Education represents the number of years of education (range 0-18). It was centered at the median value of 12 years and was included as a time-invariant, continuous variable.

Family relationships

Marital status was a time-varying categorical variable indicating if a participant was married or unmarried. By unmarried, we included those who were separated or divorced/ widowed/ never married. The number of family relationships was included as a time-varying, continuous variable. It was the combined number of the living children and living parents of the respondent and spouse/partner.

Other predictors

Time-invariant demographic variables such as participants' age at baseline, age at retirement, race/ethnicity as well as time-varying self-reported health were included in all models. We conducted separate analyses for men and women.

Statistical Analysis

The goal of this study was to determine primary predictors of bridge employment. We tested the degree to which primary predictors predict the likelihood of engaging in bridge employment at any point during the follow-up. This association was tested using logistic regression using up to eleven waves of data available through HRS. To account for correlated data structure due to repeated assessment of individuals, a logistic model was performed using weighted Generalized Estimating Equation (GEE) (Liang & Zeger, 1986), which uses a robust or "sandwich" estimator to provide a consistent estimator in correlated data, accounting for sampling weight for each wave. All analyses were conducted using the SURVEY procedures in SAS software (version 9.3) to account for differential probabilities of sampling in HRS.

Model 1.1M controlled for demographic variables for men. Model 1.2M included income to test for hypothesis 1-Ma. Model 1.3M added education and pre-retirement occupations to test for hypothesis 1-Mb. Model 1.4M added marital status in the model before looking at the interaction between marital status and other variables of interest. Model 1.5M, 1.6M, and 1.7M tested for hypothesis 1-Mc by including interaction of marital status with income, education, and pre-retirement occupations.

Similarly, model 1-1F controlled for demographic variables for women. Model 1-2F added income to test for hypothesis 1-Fa. Model 1.3F and 1.4F included marital status and family relationships, respectively, to test hypothesis 1-Fb. Model 1.5F and 1.6F tested hypothesis 1-Fc by including interaction of marital status with income and family relationships.

Results

Table 2.2, 2.3, and 2.4 present means, standard deviation, and percentages among the covariates that were tested for predicting bridge employment in men and women. The total sample included 2,243 men and 2,225 women who were employed full-time at Wave 1 and reported full or partial retirement between Wave 2 and Wave 11. Those who engage in bridge employment were 56% men, 75% married, with the average retirement age of 61.68 (standard error (SE) 0.10) years. Those who do not engage in bridge employment were 48% men, 73% married, with the average retirement age of 63 (SE 0.09).

Findings for men

Table 2.5 presents the results for testing our hypotheses on determinants of bridge employment in men. Model 1.1M showed that higher retirement age (B= -0.051, $p<0.0001$) was associated with lower likelihood of obtaining bridge employment. The number of years since retirement had a curvilinear association (B=-0.033, p=0.0002) with men's engaging in bridge

employment. The likelihood of bridge employment increased up to 2 years post-retirement, then decreased afterwards. Self-reported health status (B=0.143, p<0.0001) was positively associated with bridge employment, showing that men with good health status were more likely to engage in bridge employment. As more covariates were added to the model, the number of years since retirement, retirement age, and self-reported health status remained significantly associated with bridge employment.

Model 1.2M tested Hypothesis 1-Ma (i.e. the effect of financial means on the likelihood of bridge employment). It shows a positive linear association between household income and bridge employment among men (B=0.102, p=0.020). Model 1.3M tested Hypothesis 1-Mb (i.e. the effect of education and pre-retirement occupation on the likelihood of bridge employment), with the addition of years of education and pre-retirement occupation to the model. Model 1.3M showed that education years had a curvilinear (concave) relationship with bridge employment. The likelihood of men's obtaining bridge employment increased up to 12 years of education and decreased slightly beyond 12 years (B= -0.007, p=0.033). Moreover, those whose pre-retirement occupations were white collar or high-skilled service jobs were more likely to engage in bridge employment than those who held blue collar jobs or low-skilled service jobs as their pre-retirement occupations (B=0.083, p=0.038).

Model 1.4M showed that marital status was associated with bridge employment among men (B=0.126, p=0.021). The interaction term between the household income and marital status was added in Model 1.5M to test Hypothesis 1-Mc. No significant income effects existed among both the married and unmarried men. Model 1.6M and 1.7M tested another portion of Hypothesis 1-Mc by adding the interaction of marital status with education years and pre-retirement occupation. While the interaction between marital status and education years were

found to be statistically insignificant in Model 1.6M, education years maintained a quadratic association with bridge employment (education^2 B=-0.007, p=0.031); among unmarried men, education years have a curvilinear association with bridge employment. In Model 1.7M, there was a marginally significant interaction between marital status and pre-retirement occupation. Among married men, those who held pre-retirement white-collar job or high-skilled service jobs were less likely to engage in bridge employment than those who had blue-collar or low-skilled service jobs (B=-0.096, p=0.063). In contrast, among unmarried men, those who held pre-retirement white-collar job or high-skilled service jobs were more likely to engage in bridge employment than those who had blue-collar or low-skilled service jobs (B=0.146, p=0.004).

Findings for women

Table 2.6 presents the results of the regression models predicting bridge employment in women. Model 1.1F shows that the retirement age (B= -0.031, p=0.002) was negatively associated with bridge employment. The number of years since retirement had a negative curvilinear association with bridge employment (B=-0.018, p=0.005). The likelihood of bridge employment peaked at one year post-retirement, then decreased afterwards. Self-reported health status (B=0.193, p<0.0001) was positively associated with bridge employment. The number of years since retirement, retirement age, and self-reported health remained strongly associated with bridge employment as more variables were added for in later models.

Model 1.2F tested if financial means were associated with women's engagement in bridge employment by adding total household income (Hypothesis 1-Fa). Education years was added to the model as well to control for the basic socioeconomic status. Income was negatively associated with bridge employment (B=-0.015, p=0.002), while education was positively associated with bridge employment (B=0.048, p=0.001).

Model 1.3F and Model 1.4F tested Hypothesis 1-Fb that having extended family relationships would negatively affect bridge employment. Following our expectation, married women were less likely to engage in bridge employment (B=-0.108, p=0.041), yet contrary to the hypothesis, the number of children and living parents had a positive association with women's bridge employment (B=0.035, p=0.032). Once marital status was added in Model 1.3F, the effect of household income became insignificant.

Model 1.5F and 1.6F tested interactions of marital status with household income and family relationships (Hypothesis 1-Fc). Contrary to our hypothesis, which expected the effect of income on bridge employment would be less among married women, we found no interaction between income and marital status. Only among women with median income, those who are married were significantly less likely to engage in bridge employment (B=-0.109, p=0.025). Moreover, no interaction was detected between marital status and the number of extended family members. The number of extended family relationships were positively associated with bridge employment only among unmarried women (B=0.039, p=0.016).

Discussion

This study identified important determinants of bridge employment among men and women born between 1931 and 1941, using eleven waves of the HRS core cohort. Excluding phased retirement, 41% of men and 33% of women reported engaging in bridge employment after retirement. For both men and women, higher likelihood of bridge employment was associated with younger age at retirement and good health. Years since retirement had a negative curvilinear relationship with bridge employment in both men and women. In men, the likelihood of bridge employment peaked at two years after retirement, while in women, the likelihood peaked at one year after retirement. In many other respects, the determinants of one's

engagement in bridge employment differed by gender, as will be discussed in more detail below. It is important to note, however, that the analyses are conducted separately for me and women and the results may not be directly comparable.

Discussion regarding findings for men

Our hypotheses were based on social role theory, which assumes that individuals strive to perform socially designated gender roles as they try to reach important goals, enhance their self-esteem, and gain approval from others. However, contrary to our expectations, we found little evidence for men's bridge employment in relation to social role theory. Instead, our results implied that retired men's bridge employment may be influenced by determinants related to the physical strength to perform tasks and opportunities provided by society.

All other previous studies, despite mixed results, mentioned good health as one of the primary determinants of bridge employment (Beehr & Bennett, 2015; Pleau & Shauman, 2013). Likewise, our study found that good self-reported health was strongly associated with men's working after retirement. We also found that despite the pro-work policies implemented by the government and many employers, age discrimination may remain, and opportunities for bridge employment may not be distributed equally across men. Those who retire at younger ages were more likely to engage in bridge employment than those who retired at an older age.

We hypothesized that financial means would have a curvilinear association with bridge employment in men in that both low- and high- income men would have higher likelihood of bridge employment than middle-income men (Hypothesis 1-Ma). While low-income men may continue to fulfill financial responsibility as a main breadwinner of the household, high-income men may seek social approval and self-satisfaction from occupying a high status at work and being a competent breadwinner for his family. However, we found that household income had a

positive linear association with bridge employment. While high-income men were found to have a high likelihood of bridge employment, which was in accordance with our hypothesis, low-income men had low likelihood of bridge employment, which was contrary to our hypothesis.

As hypothesized (Hypothesis 1-Mb), those whose pre-retirement occupations were white collar or high-skilled service jobs were more likely to engage in bridge employment than those who held blue collar jobs or low-skilled service jobs as their pre-retirement occupations. On the other hand, contrary to our hypothesis, which expected education years to have a positive association with engagement in bridge employment, education years had a negative curvilinear association with bridge employment. The likelihood of men engaging in a bridge employment increased up to 12 years of education and decreased slightly afterwards. Men who served in white collar or high-skilled pre-retirement occupations may have opportunities to engage in a bridge employment with and many years of experiences and skills, which may not be obtained easily by their younger and stronger counterparts who may be more appropriate for blue collar, low-skilled jobs which often require high physical strength. In contrast, blue-collar or low-skilled service jobs may easily be replaced by younger and stronger men, which may reduce the opportunities for retired job seekers. The likelihood of bridge employment peaked at 12 years of education, which is the mean and median number of education years among men. This may be due to the optimal balance of the retirees' willingness to work and the availability of bridge jobs. Men with less-than-high school education may have limited employment opportunities despite their willingness to continue working. They may want to complement their retirement income and low savings, yet they have only few opportunities with less-than-average education, little job skills as well as weaker physical strength compared to their younger counterparts. Men with average education may still want to work post-retirement because they would like to maintain

their pre-retirement living standards and lifestyles, which may be difficult with their post-retirement income. Many of them are likely to qualify for bridge employment with average education as well as job skills and experiences through their pre-retirement career. Moreover, the income effect disappeared when we controlled for education and pre-retirement occupation. This finding implies that most of the effect of post-retirement household income on engaging in bridge employment can be accounted by the effect of education and pre-retirement occupation. Certain amount of education may have made it easier for a man to work for an occupation requiring high skills and know-hows, which in turn, may influence their obtaining bridge employment. Education, representing one's early-life socioeconomic status (SES) (Herd, Goesling, & House, 2007) may influence one's late-life SES partly by affecting his engagement in bridge employment.

Contrary to our hypothesis (Hypothesis 1-Mc), among married men, those with blue collar or low-skilled pre-retirement career were more likely to engage in a bridge employment than those with white collar or high-skilled career. Married men may seek more leisure time with his family after retirement, once they are already financially established to support for his family members. Among those with median income and education, however, married men were marginally more likely to obtain a bridge employment than unmarried men. This partially support our hypothesis based on social role theory, because married men with average education and income may seek for bridge employment more than unmarried men to maintain pre-retirement living standards and lifestyles as a breadwinner for his family.

Discussion regarding findings for women

As most previous studies have found, good self-reported health was strongly associated with women's bridge employment. In addition, women who retired at a younger age were

significantly more likely to engage in bridge employment than those who retired at an older age. Women's likelihood of bridge employment increased only up to one year post-retirement, then decreased for those who had more than a year since retirement. These differences might have been due to deteriorating physical or cognitive health with age, which can prevent one from performing work properly. Moreover, discrimination may still exist in many work places and opportunities may not have been distributed equally across all women (Gayle, Golan, & Miller, 2012; Penner, Toro-Tulla, & Huffman, 2012; Reid, 1998).

We found a positive association between household income and bridge employment, which disappeared when we additionally controlled for marital status. Married women were found to be less likely to engage in bridge employment than unmarried women. This finding was consistent with our hypothesis. More gender-specific expectations for a married woman to be a caring and nurturing person combined with possible financial dependence on their spouse's income may have led to less engagement in bridge employment among married women than among the unmarried.

This evidence with regard to social role theory, however, was not as strong as expected, since contrary to our hypothesis (Hypothesis 1-Fb), the number of children and living parents was positively associated with bridge employment. Women's gender roles designated by our society as a caregiver for family members may not discourage them from engaging in a bridge employment. This finding echoes previous longitudinal studies on women's caregiving and work which found that women are as likely to be combining working and caregiving as they are to be caregivers exclusively (Moen, Robison, & Dempster-McClain, 1995; Moen et al., 1994; Moen & Chermack, 2005; Pavalko & Artis, 1997). In addition, caregiving is often short-term and intermittent and does not necessarily interrupt women's labor force participation (Moen et al.,

1994); in addition, bridge employment tends to be less intensive than career jobs, which may enable women to engage in both.

Especially among unmarried women, their decision to obtain bridge employment may depend on whether they can financially support themselves and their dependents. For instance, among unmarried women, the number of family relationships had a positive association with bridge employment. Having children or living parents may be financially demanding, and may lead to less saving for post-retirement years. This financial necessity to support other family members tends to be more severe in unmarried women than in married women, as unmarried women need to support other family members by their own financial means. Furthermore, women's income tends to be lower than men's, and unmarried women's pensions may be reduced because of their nonlinear career trajectory throughout their life course (Settersten & Hagestad, 1996). Therefore, unmarried women with more children and living parents may often need to work in their postretirement years to support themselves and their dependents.

Moreover, education, which was added to control for basic socioeconomic status, maintained a significantly positive association with bridge employment. Women with more education, regardless of marital status, household income, and the number of children and living parents, were more likely to engage in a bridge employment. This finding may be due to the opportunities only available for more educated older women, yet further studies are necessary to explain the role of education in women's bridge employment.

Strengths, Limitations and Future Research

Strengths of the present study are worth noting. First, this study used eleven waves of nationally representative study population to identify determinants of bridge employment in our longitudinal analyses. Second, we performed separate analyses for men and women to account

for fundamental gender differences in retirement processes, career trajectories, and social roles over the life course. Third, our longitudinal analyses accounted for correlated data structure in HRS by using weighted Generalized Estimating Equation (GEE).

However, the present study is not without its limitations. As mentioned above, the HRS core sample was born between 1931 and 1940 and may not be generalizable to those who were born after 1940. Older HRS core samples were encouraged to retire early in the early-1990s during the initial waves of HRS, while younger HRS core samples were on the brink of the transition to the implementation of the pro-work policy. To fully explore the lagged effects of pro-work policy implementation, additional analyses using later cohorts will be necessary. With the baby boomer generation starting to leave their career jobs, increasing numbers of older Americans are expected to be seeking bridge employment (Beehr & Bennett, 2015), perhaps for different reasons than those of their older counterparts. Understanding how and why retirees choose to remain working later in life is the key for the government and employers to utilize the rich pool of experienced workers who are willing to or need to work beyond career employment. To our knowledge, there is no relevant study using recent cohorts, and future studies should explore this important topic. Second, we did not specifically exclude those who retired early from those retirees who retired at or after the retirement age eligible for Social Security benefits. Determinants of bridge employment among early retirees may differ from those among retirees who retired at their normal retirement age, which should be explored by further research. Moreover, the definition of BE in this study includes only those who work for less than 10 years after career employment. However, it is possible that some subjects may have started employment but not followed for 10 years to determine that they will stop before reaching 10 years. In such respondents, it is not possible to distinguish between those with true BE and

unretirement which includes working full-time for more than 10 years post-retirement, and consequently, the differences between the BE and the comparison group may have been diluted. Lastly, we used self-reported measures from HRS, which may be subject to recall bias. Fourth, the average income and education levels have increased over more than 20 years of follow-up, which may have biased our results.

Conclusion

In sum, our study used eleven waves of a nationally representative longitudinal data to identify important determinants of bridge employment in men and women in separate analyses. We found that in men and women, engagement in bridge employment was positively affected by good health, younger retirement age, shorter years since retirement. Education years, which represent early-life socioeconomic status, were found to be the main driver for men's bridge employment, and marital status was a strong determinant of women's bridge employment.

Via separate analyses for men and women, this study shows that men's bridge employment is often driven especially by his early-life socioeconomic status, rather than his high occupational ability or self-esteem in the work place, while women's bridge employment is significantly influenced by her marital status, which may partly be due to women's nonlinear career trajectories. While such findings should be stated with caution since the separate analyses for men and women preclude more definitive statements on the statistical robustness of gender differences in the determinants of BE and health consequences of BE, our analyses based on the social role theory account for the fundamental gender differences which may influence retirees' engagement in BE, which may deserve a particular attention in policy making. Gender-specific

policy in support of gradual retirement may lead to more life satisfaction in one's retirement years as well as social productivity.

Figure 2.1 Eligibility Criteria

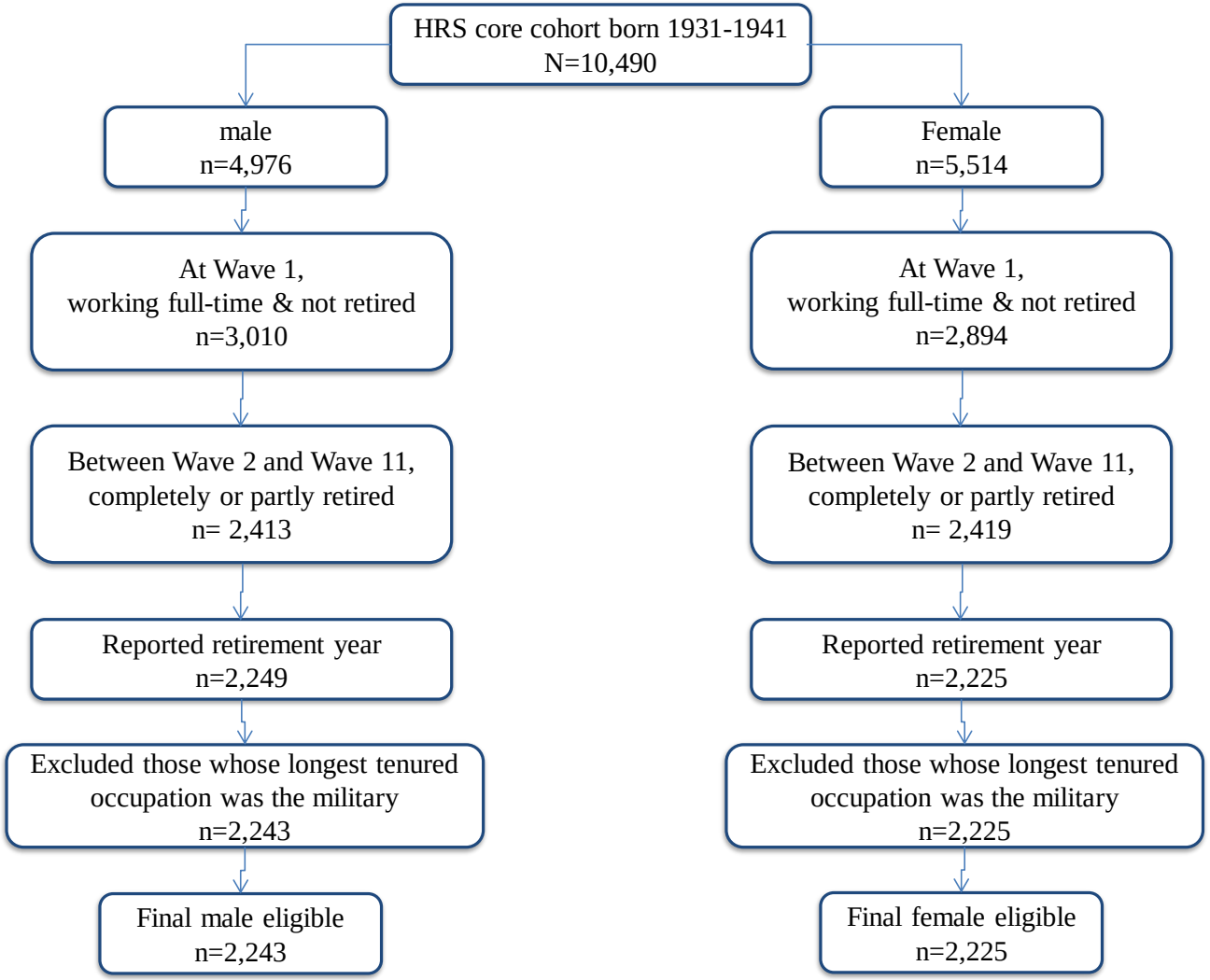


Figure 2.2 Definition of Bridge Employment

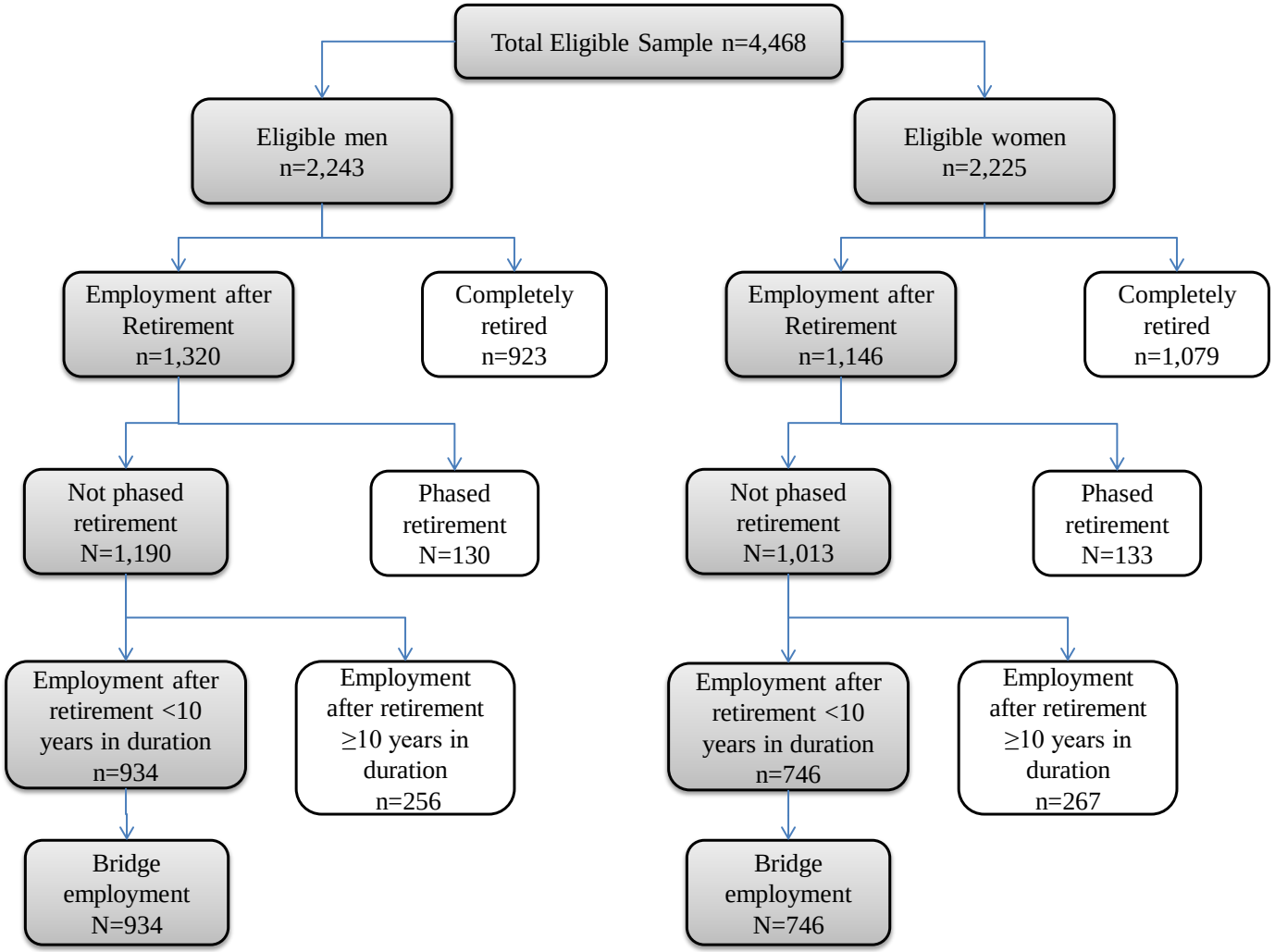


Table 2.1 Classification of Occupation Categories based on the HRS coding (from the 2000 Standard Occupational Codes (SOCs))

White collar	Management occupation
	Business operations special
	Financial specialists
	Computer and math occupations
	Architecture and engineering
	Life physical social sciences
	Legal occupations education training library arts design entertainment occupations
	Sales occupations
High-skilled service	Community social services occupations
	Healthcare practices and technicians
	Protective services occupations
	Food prep and serving occupations
Low-skilled service	Building grounds clean maintenance
	Personal care and service occupations
	Office and administrative support occupations
Blue collar	Farm fish forestry occupations
	Construction trades
	Extraction workers
	Install maintenance repair workers
	Production occupations
	Transport material moving
Military	Military specific occupations

Table 2.2 Baseline characteristics by bridge employment status, weighted by respondent-level sample weights, Health and retirement study

	Participants Not Engaging in Bridge Employment (n=2,788)	Participants Engaging in Bridge Employment (n=1,680)	Total (n=4,468)
Baseline Age (SE)	57.30 (0.06)	57.15 (0.08)	57.24(0.05)
Retirement Age (SE)	63.00 (0.09)	61.68 (0.10)	62.47(0.07)
Gender, %			
Female	52.31	44.22	49.23
Male	47.69	55.78	50.76
Race/Ethnicity,%			
White	13.44	12.61	13.13
Non-White	86.55	87.39	86.87
Self-reported health	2.23 (0.02)	2.57(0.02)	2.36 (0.02)
Occupation			
White collar/ high-skilled service	48.60	50.39	49.36
blue collar/ low-skilled service	51.39	49.61	50.64
Household Income at Retirement (in $1,000) (SE)	0.11 (0.02)	0.15 (0.02)	0.13(0.01)
Education Years (SE)	12.61 (0.05)	13.01 (0.07)	12.80(0.04)
Marital Status, %			
Married/Partnered	72.89	74.92	73.66
Divorced/Separated/Widowed/Never married	27.11	25.08	26.33
Family (Number of Living Parents/Children) (SE)	3.68 (0.04)	3.92 (0.05)	3.77(0.04)

Abbreviations: SE, standard error

Table 2.3 Baseline characteristics of *MEN* by bridge employment status, weighted by respondent-level sample weights, Health and retirement study

	Participants Not Engaging in Bridge Employment (n=)	Participants Engaging in Bridge Employment (n=)	Total (n=)
Baseline Age (SE)	57.35 (0.09)	57.11 (0.11)	57.25 (0.07)
Retirement Age (SE)	62.88 (0.13)	61.63 (0.14)	62.36 (0.10)
Race/Ethnicity,%			
White	10.80	11.58	11.13
Non-White	89.20	88.42	88.87
Self-reported health	2.23 (0.03)	2.56 (0.03)	2.37 (0.02)
Occupation			
White collar/ high-skilled service	45.22	50.85	47.79
blue collar/ low-skilled service	54.78	49.10	52.21
Household Income at Retirement (in $1,000) (SE)	0.09 (0.03)	0.18 (0.03)	0.13 (0.02)
Education Years (SE)	12.55 (0.09)	13.03 (0.09)	12.75 (0.06)
Marital Status, %			
Married/Partnered	83.59	85.88	84.56
Divorced/Separated/Widowed/Never married	16.41	14.12	15.44
Family (Number of Living Parents/Children) (SE)	3.74 (0.07)	3.97 (0.07)	3.84 (0.05)

Abbreviations: SE, standard error

Table 2.4 Baseline characteristics of WO*MEN* by bridge employment status, weighted by respondent-level sample weights, Health and retirement study

	Participants Not Engaging in Bridge Employment (n=)	Participants Engaging in Bridge Employment (n=)	Total (n=)
Baseline Age (SE)	57.24 (0.09)	57.19 (0.12)	57.23 (0.07)
Retirement Age (SE)	63.03 (0.13)	61.74 (0.15)	62.59 (0.10)
Race/Ethnicity,%			
White	15.86	13.89	15.19
Non-White	84.14	86.11	84.81
Self-reported health	2.23 (0.03)	2.59 (0.04)	2.35 (0.02)
Occupation			
White collar/ high-skilled service	51.76	49.81	51.01
blue collar/ low-skilled service	48.24	50.19	49.00
Household Income at Retirement (in $1,000) (SE)	0.12 (0.02)	0.12 (0.03)	0.12 (0.02)
Education Years (SE)	12.67 (0.07)	13.00 (0.09)	12.78 (0.05)
Marital Status, %			
Married/Partnered	63.19	61.20	62.51
Divorced/Separated/Widowed/Never married	36.81	38.80	37.49
Family (Number of Living Parents/Children) (SE)	3.62 (0.06)	3.85 (0.08)	3.70 (0.05)

Abbreviations: SE, standard error

Table 2.5 Determinants of bridge employment in *MEN*

	Men													
	Model 1.1M		Model 1.2M		Model 1.3M		Model 1.4M		Model 1.5M		Model 1.6M		Model 1.7M	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Intercept	-2.07***	0.148	-2.000***	0.140	-1.581***	0.161	-1.674***	0.171	-1.685***	0.168	-1.664***	0.169	-1.672***	0.173
wave	0.000	0.022	-0.008	0.022	-0.010	0.023	-0.005	0.023	-0.006	0.024	-0.005	0.023	-0.005	0.024
yrs_ret	0.042	0.062	0.056	0.063	-0.060	0.070	-0.064	0.071	-0.063	0.071	-0.064	0.071	-0.064	0.071
yrs_ret_sq	-0.033***	0.009	-0.033***	0.009	-0.026**	0.010	-0.026**	0.010	-0.026**	0.010	-0.026**	0.010	-0.026**	0.010
ret_age_cent	-0.051***	0.012	-0.050***	0.012	-0.055***	0.012	-0.057***	0.012	-0.056***	0.012	-0.056***	0.012	-0.056***	0.012
race	0.005	0.040	0.022	0.043	0.024	0.048	0.037	0.049	0.037	0.049	0.037	0.049	0.037	0.049
health	0.143***	0.035	0.123***	0.033	0.112**	0.042	0.112**	0.042	0.112**	0.042	0.113**	0.041	0.112**	0.042
Income			0.102*	0.044	0.038	0.052	0.009	0.050	-0.014	0.067	0.008	0.051	0.009	0.050
Education					0.008	0.016	0.012	0.016	0.012	0.016	0.013	0.016	0.010	0.021
Education^2					-0.007*	0.003	-0.007*	0.003	-0.007*	0.003	-0.007*	0.003	-0.007*	0.003
White collar/ Skilled service					0.083*	0.040	0.077	0.041	0.076	0.041	0.146**	0.051	0.077	0.041
Married							0.126*	0.055	0.136*	0.060	0.117*	0.052	0.122*	0.059
Income xMarried									0.035	0.063				
White collar/ Skilled service x Married											-0.096	0.052		
Education x Married													0.003	0.018

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.* Abbreviations: SE, standard error

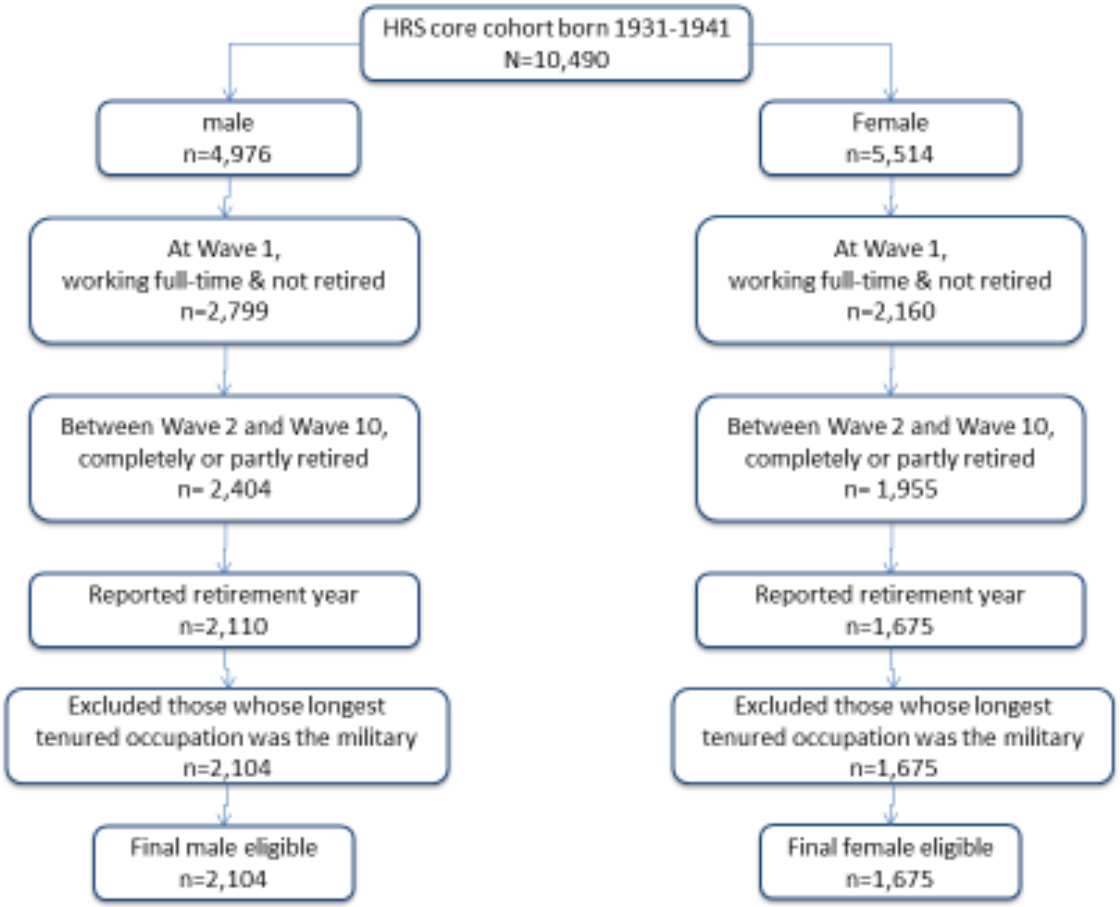
Table 2.6 Determinants of bridge employment in *WOMEN*

	Women											
	Model 1.1F		Model 1.2F		Model 1.3F		Model 1.4F		Model 1.5F		Model 1.6F	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Intercept	-2.380***	0.185	-2.433***	0.186	-2.420***	0.187	-2.573***	0.201	-2.567***	0.193	-2.575***	0.198
Wave	-0.022	0.024	-0.017	0.025	-0.019	0.025	-0.019	0.026	-0.019	0.027	-0.019	0.025
Years since retirement	-0.018	0.055	-0.034	0.055	-0.029	0.055	-0.032	0.055	-0.032	0.048	-0.033	0.055
Years since retirement^2	-0.018**	0.006	-0.018**	0.006	-0.018**	0.006	-0.017**	0.006	-0.017**	0.005	-0.017**	0.006
Retirement age	-0.031**	0.010	-0.034**	0.011	-0.037***	0.011	-0.035**	0.011	-0.035**	0.013	-0.035**	0.011
White race	0.028	0.043	0.005	0.046	-0.008	0.044	-0.017	0.045	-0.017	0.049	-0.019	0.045
Self-reported health	0.193***	0.042	0.195***	0.040	0.195***	0.040	0.201***	0.041	0.201***	0.040	0.201***	0.041
Income			-0.145**	0.046	-0.094	0.057	-0.098	0.058	-0.097	0.054	-0.098	0.058
Education			0.048***	0.014	0.043**	0.014	0.046**	0.014	0.046**	0.017	0.047**	0.015
Married					-0.092	0.049	-0.108*	0.053	-0.109*	0.049	-0.014	0.101
Family							0.035*	0.016	0.035	0.019	0.039*	0.016
Income x Married									-0.017	0.046		
Family x Married											-0.026	0.018

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$. Abbreviations: SE, standard error

Appendix 2.1

Figure 2.3 Eligibility Criteria when only including FT employment at wave 1



CHAPTER 3

Bridge Employment and Mental Health

Background

Depression is one of the most representative and devastating mental health disorders in late life due to its dire consequences (Aziz & Steffens, 2013). About 4 percent of community-living older adults 65 years and older (1.2 – 1.8 million) in the US have current depressive disorder, and about 12 percent of elderly population suffer from depression in the hospital and long-term-care settings (Aziz & Steffens, 2013). Depression is associated with increased risk of morbidity, increased risk of suicide, decreased physical, cognitive and social functioning, greater self-neglect, increased cardiac and cerebrovascular disease, and increased neurological conditions, all of which are in turn associated with increased mortality (Blazer, 2003; Fiske et al., 2009; Schulz et al., 2000). Even at the minor degree, depression has been associated with impairment similar to that of major depression, including impaired physical function, increased disability days, poorer self-rated health, perceived low social support, and excess service utilization (Hybels, Blazer, & Pieper, 2001). Moreover, geriatric depression is costly; total health care costs were 47-51% higher for depressed elders than non-depressed, even after adjustment for chronic medical illness (Katon et al., 2003). Due to its numerous comorbid chronic conditions which altogether destroy elderly health, depression in late life is an urgent public health issue which should be addressed clinically as well as politically to reduce its prevalence.

Retirement Effects on Mental Health

While late-life depression is observed in one's post-retirement years, retirement itself was found to have little negative effect on depression. Most studies that have looked at retirement effects on mental health showed that retirement has positive impact on mental health (Johnston & Lee, 2009; Insler, 2014; Mein, Martikainen, Hemingway, Stansfeld, & Marmot, 2003; Salokangas & Joukamaa, 1991), even though there may be some possibility of endogeneity bias in these findings (Dave et al., 2008). A Kaiser Permanente study found that retirement was associated with less stress (Midanik, Soghikian, Ransom, & Tekawa, 1995). More specifically, a recent study by Jokela et al. found that voluntary early retirement and statutory retirement were found to be associated with better mental health (Jokela et al., 2010). Interestingly, a study using the Health and Retirement Study (HRS) found poorer mental health for workers who experience involuntary job loss (Gallo et al., 2000). The same study found that re-employment following job loss was associated with better mental health at follow-up (Gallo et al., 2000). Authors speculated that mental health may be adversely affected by involuntary job loss because it prevents assets accumulation needed for retirement (Gallo et al., 2000). Moreover, Mein et al., using the Whitehall study, found that mental health functioning improves after retirement but only in high employment grades, who are likely to be financially well-established for post-retirement years (Mein et al., 2003). Indeed, the modifying role of financial resources in the association between retirement and mental health is consistent with the finding by Ettner, which underscored the role of family income as a determinant of good mental health (Ettner, 1996).

Increase in Non-traditional Retirement Process

However, simply exploring retirement effects on mental health may have little meaning, since the retirement environment nowadays has been changed in that only about a half of all

workers go through a traditional retirement experience by abruptly ceasing all paid work in pursuit of a life of leisure and hobbies (Han & Moen, 1999; Maestas, 2010; Phyllis Moen et al., 2001a; R. L. Pleau, 2010; R. Pleau & Shauman, 2013). In the meantime, an increasing number of retirees stay economically productive after retirement by engaging in bridge employment, which is employment after retirement from a full-time career job. Bridge employment may redefine retirement as a "process" of multiple transitions over one's older years, rather than a simple transition from a working state to a non-working one (Maestas, 2010; Wang et al., 2008).

Bridge Employment and Depressive symptoms

Despite the increasing trend of bridge employment, there exists little systematic knowledge on its mental health consequences. Very few studies so far have explored the effects of bridge employment on post-retirement outcome related to mental health. Studies examining the consequences of bridge employment have largely focused on outcomes such as retirement adjustment and life satisfaction, which were found to be beneficial (Calvo et al., 2009; Choi, 2001; Kim & Feldman, 2000). However, specific mental health outcomes have been mostly neglected by researchers. Only one study explicitly explored the effects of bridge employment on post-retirement health using a longitudinal set of data. Zhan, Wang, and Liu, in their 2009 study, used the first 4 waves of HRS to examine the relationship between bridge employment and retirees' health outcomes including depression. They found that bridge employment related to one's pre-retirement career field, also known as career bridge employment, was associated with less depressive symptoms compared to not engaging in bridge employment or engaging in non-career-related bridge employment (Zhan et al., 2009). While very little is known about the health consequences of bridge employment, this study aims to complement the current research gap by

further investigating the effects of bridge employment on depressive symptoms among older adults.

This study aims to enhance the current understanding of the association between bridge employment and mental health by investigating the potential social mechanisms of how BE affects retirees' mental health in terms of depressive symptoms. In addition to simply investigating BE effects on depressive symptoms, we test a potential modifying role of the childhood and adult socioeconomic status – education and income – in this association. Moreover, we also test if gender and extended family relationships modify this association. Understanding social mechanisms is crucial for the policy implication since it enables the policy implementation for targeted groups. Our study may serve as a stepping stone for many future studies investigating the social mechanisms connecting diverse retirement processes and post-retirement health, which may eventually enhance older adults' wellbeing and save budget for the future government through appropriate policy implementations.

Theoretical background

In the present study, we use continuity theory (Atchley, 1989) and social role theory (Eagly & Steffen, n.d.) as general frameworks for understanding the hypothesized mental health benefits of bridge employment. Continuity theory highlights the gerontological aspect of retirement adjustment; it suggests older adults adapt to change by keeping a consistent life pattern after retirement, which may preserve their health. Social role theory, on the other hand, emphasizes the gender differences in retirement. A retirement process and post-retirement lifestyle of men and women differs due to socially designated gender roles, which may influence health in men and women differently as well.

Continuity Theory

Continuity theory suggests that older adults attempt to preserve existing internal and external structures to avoid the experience of stressful disruption (Atchley, 1989). As long as older adults strategize to adapt to retirement transition and maintain their lifestyle and social contacts, it is unlikely that they experience significant drops in health and wellbeing (Beehr & Bennett, 2015; Wang, 2007). Bridge employment provides a means to achieve continuity after retirement transition by allowing retirees to continue to work, and consequently, maintain their familiar life patterns and social networks (Beehr & Bennett, 2015; von Bonsdorff, Shultz, Leskinen, & Tansky, 2009). Therefore, in accordance with continuity theory, those who engage in bridge employment will have better mental health than those who have fully retired. By preserving the pre-retirement lifestyle after retirement, one can experience retirement transition smoothly and satisfactorily, which can benefit one's mental health.

Furthermore, retirees with high socioeconomic status (SES) may benefit more from bridge employment than those with low SES. Those with high income and education may voluntarily choose to continue their lifestyle of working out of enjoyment, rather than to fulfill financial needs to sustain their pre-retirement living standards. Since stressors associated with financial strain are associated with persistent depressive symptoms (Fiske, Gatz, & Pedersen, 2003; Mojtabai & Olfson, 2004), we expect that the benefits of bridge employment may be maximized among those with high socioeconomic status who can work relatively free from financial stress. Therefore, the beneficial effects of bridge employment on health would be stronger among high-income, high-education group than among those with low SES.

Social role theory

According to social role theory, our social structure divides men and women in terms of labor, occupational roles, and hierarchical status (Eagly & Steffen, n.d.) Men are more likely

than women to occupy wage labor as opposed to domestic labor and to occupy high-status as opposed to low-status roles (Cejka & Eagly, 1999; Eagly, Wood, & Diekman, 2000; Eagly & Steffen,1984; Eckes & Trautner, 2000). Despite the ongoing shift in gender roles in social structure, men still take major responsibility for providing financially for their families in general (Cejka & Eagly, 1999; Riggs, 1997). These stereotypic gender roles coexist with other roles based on factors such as family relationships and occupations, and affect individual behaviors. Specifically, individuals strive to take gender roles into account as they try to reach important goals, enhance their self-esteem, and gain approval from others, and obtain self-satisfaction by living up to gender-appropriate behavior (Eagly et al., 2000).

From social roles perspective, men would have more beneficial mental health consequences from bridge employment than women would. Men's bridge employment is a means to continue stereotypic gender responsibility by providing financial support for his family even after retirement, which may make them confident, proud, and approved. Women's bridge employment may be considered as an additional burden on top of their traditional responsibility as a caregiver and homemaker for her family, and thus women may become tired and stressed fulfilling double-duties. In addition, men who have a number of children and living parents may have more mental health benefits from bridge employment than those who have only few, since they have more people to give them social approval and cooperation which may lead to more self-satisfaction and self-esteem, once they fulfill the traditional gender obligation as a breadwinner for the family. Yet women with many children and living parents may have more domestic obligations to fulfill on top of their bridge job than their counterparts with small family members, and therefore, may obtain less benefit from bridge employment on mental health.

Aims & Hypotheses

We aim to investigate the effects of bridge employment on depressive symptoms and how these associations are modified by gender, income, education, and family relationships. Our hypotheses are developed based on continuity theory and social role theory as well as previous research studies mentioned above.

Aim 2-1

Investigate the association between bridge employment and depression

Hypotheses 2-1

Engaging in bridge employment on average is associated with fewer depressive symptoms.

Aim 2-2

Investigate if gender modifies the association between bridge employment and depression

Hypotheses 2-2

The beneficial effect of bridge employment on depressive symptoms is stronger among men than among women.

Aim 2-3

Investigate if income and education modifies the association between bridge employment and depression

Hypothesis 2-3

High income and high education on average increase the beneficial effect of bridge employment on depressive symptoms.

Aim 2-4

Investigate if family relationships modify the association of bridge employment with depression.

Hypothesis 2-4

Having more extended family relationships on average increases the beneficial effect of bridge employment on depressive symptoms among men, while decreases the beneficial effect among women.

Methods

Data Source: Health and Retirement Studies (HRS)

The Health and Retirement Study (HRS) is a longitudinal study of US adults who are 50 years and over. The details of study design have been published elsewhere (Juster & Suzman, 1995). The survey, which has been fielded every 2 years since 1992, was established to provide a national resource for data on the changing health and economic circumstances associated with ageing at both individual and population levels (Sonnega et al., 2014). HRS includes eligible spouses as respondents and oversamples blacks, Hispanics, and residents of Florida (Juster & Suzman, 1995). The HRS data used in this study was obtained from RAND HRS data set (version N) prepared by the RAND Center for the Study of Aging with support from Social Security Administration (SSA) and National Institute of Aging (NIA).

Eligibility Criteria

This study uses HRS core cohort of the Health and Retirement Study, who were born between 1931 and 1941 and were interviewed biennially from 1992 (age 50-61) to 2010 (age 60-79). The total size of the HRS core cohort classified by birth year is n=10,490, including 4,976 males and 5,514 females.

Among the HRS core cohort respondents, only those eligible for our criteria were included in our study to examine the association of bridge employment with its post-retirement depressive symptoms (Figure 3.1). First, only participants who reported working full-time or part-time and were not retired at wave 1 were included. We did not include those who were

retired years ago to exclude those who were retired early. Our study aims to investigate proximal effect of bridge employment within one wave, or two years, of obtaining one (n=5,904, (3,010 males and 2,894 females)).

Our study population should already be retired, because our exposure (bridge employment) and outcome (depressive symptoms) are both post-retirement variables. Thus among 5,904 males and females who were working and not retired, we excluded those who did not retire between wave 2 and wave 11. We included only those who reported as completely or partly retired between waves 2 and 11 and also reported the year of retirement (n= 4,474 (2,249 males and 2,225 females)).

Finally, we excluded those whose longest tenured occupation was the military (n=6) since military careers are unique in their patterns of retirement, which yielded our final sample with 4,468 males and females (2,243 males and 2,225 females).

Outcome Variable: Depressive Symptoms

Depressive symptoms were measured with the Center for Epidemiologic Study of Depression (CESD) scale, the most commonly used survey measure of depressive symptomatology in studies of older adults. The scale used in this study is the modified 8-item version of the original CESD which consists of 20 items (Radloff, 1977). The scale asks if the respondent experienced specific symptoms 'much of the time' during the week preceding the interview, and responses are scored in yes/no which are recoded as 1/0 with potential total scores ranging from 0 to 8. The specific items included in the scale are following: if a respondent felt depressed; felt activities were efforts; slept restlessly; was happy; felt lonely; felt sad; could not get going; enjoyed life. Our outcome variable is the summary score of the 8 items which is designed so that the higher the score the more negative the respondents' feelings in the past

week. Therefore, the scores of the items asking if the respondent "was happy" and "enjoyed life" for the most time were reversed before adding to the summary score (range 0-8).

The outcome of this study measures the summary score of the number of depressive symptoms, rather than the diagnosis of depressive disorder based on the certain number of symptoms. Since minor depression has been associated with impairment similar to that of major depression (Aziz & Steffens, 2013), even the slight reduction in the summary score may be meaningful in prevention and improvement of the depressive condition.

Primary Predictor Variable: Bridge Employment

The primary predictor variable for Aim 2 is bridge employment. Though there is an agreement among researchers that bridge employment is "employment following a full-time career job," (Adams & Beehr, 2003; Beehr & Bennett, 2015; Cahill et al., 2006), there are some inconsistencies in terms of its detailed definition, given that retirement process being so diverse. For the purpose of this study, we defined bridge employment as participation in the labor force for less than 10 years for an employer different from his or her career, after declaring retirement from one's career employment, regardless of the length of time an individual is out of the labor force after retirement (Figure 3.2). Bridge employment in this study excluded work for the same employer as one's long-term employer, and thus is distinguished from "phased retirement," which means gradual reduction of work with a long-term employer as an older employee approaches full retirement (Cahill et al., 2006; Chen & Scott, 2006). Moreover, we excluded employment for 10 years or more after one's retirement from our definition of bridge employment. Bridge employment for 10 years or more would most likely be the employment after early retirement (Feldman, 1994), which may differ from bridge employment after regular retirement in terms of its determinants and consequences. After following our definition, we

identified 934 men (42%) and 746 women (34%) out of 2,243 men and 2,225 women eligible for our study.

Covariates

Income

Total household income was the sum of all income in a household, which included the respondent's and spouse's individual earnings, employer pension or annuity, Social Security income, individual unemployment or workers' compensation, food stamps, household capital income as well as alimony, insurance, and inheritance. Total household income was log-transformed and centered at the median value and included as a continuous, time-invariant variable at the baseline, which in this case was the time at one's retirement. In addition to total household income, individual wealth was originally included (not shown), but was not associated with bridge employment in either men or women, and therefore, was not included in any of our models.

Education

Education represented the number of years of education (range 0-18). It was centered at 12, which was the mean and the median value and was included as a time-invariant, continuous variable.

Family relationships

Marital status was a time-varying categorical variable indicating if a participant was married or unmarried. It was created using current marital status reported for each wave. By married, we included those who were married or partnered. By unmarried, we included those who were separated or divorced/ widowed/ never married.

The number of family relationships was included as a time-invariant, categorical variable. It was the combined number of the living children and living parents of the respondent and

spouse/partner at one's retirement. The four categories include one or less, two to three, four to six, and seven or more combined family relationships.

Other predictors

Demographic variables such as participants' age at retirement and race/ethnicity were included as time-invariant covariates. Race/ethnicity was a binary variable with 1 representing White/Caucasian and 0 representing all others. Other time-varying covariates included the number of years since retirement, marital status, and two distinct health variables: the number of medical conditions and physical function disability.

The number of medical conditions was the summary score of the answers to a series of questions asking the respondent if a doctor has ever diagnosed him/her with certain medical conditions. The conditions include high blood pressure or hypertension; diabetes or high blood sugar; cancer or a malignant tumor of any kind except skin cancer; chronic lung disease except asthma such as chronic bronchitis or emphysema; heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; stroke or transient ischemic attack (TIA); emotional, nervous, or psychiatric problems; and arthritis or rheumatism (range 0-8).

Physical functioning was the summary score of the answers to a series of questions asking the respondent if he/she has any difficulty performing a certain function. The functions being asked included running or jogging a mile; walking several blocks; walking one block; sitting for about 2 hours; getting up from a chair; climbing several flights of stairs; climbing one flight of stairs; stooping, kneeling, or crouching; extending arms above shoulders; pushing or pulling large objects; lifting or carrying over 10 pounds; picking up a dime from the table; walking across a room; getting in and out of bed; bathing; dressing; and eating (Chien, Campbell, Hayden, Hurd, Main, Mallett, Martin, Meijer, Moldoff, Rohwedder, & Clair, 2014).

Participants were told to exclude any difficulties expected to last less than three months. The response options include yes (some difficulty); no (no difficulty); can't do; and don't do. The answers to the physical functioning questions were coded so that 1 representing "can't do" or "yes" (some difficulty) and 0 representing "no." While "don't do" responses were coded as missing, some of them were recoded to minimize the potential bias following the strategy that Pool used in her 2016 study (Appendix 3.1). A person may not do the function because he or she cannot do the function without difficulty, which may underestimate the final summary score where missing responses are added as the score 0 (Pool, 2016). The final physical functioning summary score ranges from 0 to 17, with 0 being no limitation and 17 being the highest degree of limitation.

Statistical methods

Time-dependent Confounding & Marginal Structural Models (MSMs)

Time-dependent confounding refers to covariates that are simultaneously confounders and mediators (Hajat, Kaufman, Rose, Siddiqi, & Thomas, 2011). Time-varying confounders in our study include health-related variables such as the number of medical conditions and physical function disability as well as the number of years since retirement and marital status. To account for these time-varying covariates by traditional regression approach may lead to over-adjustment of estimates (Robins, Hernan, & Brumback, 2000). Moreover, we controlled for time-varying depressive symptoms prior to obtaining bridge employment to investigate immediate impact of bridge employment on mental health. The hypothesized direct acyclic graph (DAG) (Figure 3.3) demonstrates time-dependent confounding in our study. For example, the number of medical conditions is a confounder at wave t (L_t), while it predicts both one's bridge employment in the subsequent wave t+1 (exposure,) and depressive symptoms measured in CESD scores (outcome,

$CESD_{t+1}$). Simultaneously, it behaves as a mediator in that bridge employment (BE_{t+1}) may predict the number of medical conditions (L_{t+1}), which in turn, may predict one's depressive symptoms. To account for time-dependent confounding in the association between bridge employment and depressive symptoms, we used marginal structural models (MSMs) where counterfactual models were fit to a pseudo-population constructed by inverse probability weights (IPW) (Hernán, Brumback, & Robins, 2000).

Inverse probability of exposure weights (IPW)

In MSMs, inverse probability of exposure weights (IPW) is used to account for time-dependent confounding. IPW are formed based on the ratio of probability densities of engaging in bridge employment (Cole & Hernan, 2008; Robins, Hernan, & Brumback, 2000), conditional on baseline and time-varying values of the potential confounders (Brumback, Hernán, Haneuse, & Robins, 2004; Hernán et al., 2000). Then counterfactual models were fit to a pseudo-population constructed by inverse probability weights (Hernán et al., 2000).

Then we stabilized IPW weights to standardize the distribution of covariates in the entire study population. In our study, the numerator is the probability of the subject not engaging in bridge employment, conditional on the past history of bridge employment and baseline (time-invariant) covariates, while the denominator is the probability of the subject not engaging in bridge employment at a specific time conditional on time-invariant and time-dependent covariates. Since bridge employment is a binary variable, we used the pooled logistic regression to calculate these probabilities (Hajat et al., 2011).

Trimming of Stabilized Weights & Final MSMs

Very large values of the stabilized weight or means far from 1 indicated a possible misspecified weighting model (Cole & Hernán, 2008). To produce reasonable distribution of

weights for MSM models of bridge employment and depressive symptoms, weights were trimmed at 1st and 99th percentile, which resulted in means close to 1 and narrower range of values. The means and standard deviations of trimmed IPW calculated for each wave for each subject are presented in Table 3.1. Subsequently, we multiplied the HRS survey weights to these IPW to create the final MSM weights to be applied to investigate the association of BE with CESD.

Model 2.1 tested overall effects of bridge employment on depressive symptoms (hypothesis 2.1). Model 2.2 tested for gender differences in these effects (hypothesis 2.2). Model 2.3 and Model 2.4 tested the interaction effects of income and education, respectively, in the association between bridge employment and depressive symptoms (hypothesis 2.3). In Model 2.5, we first tested the interaction by family relationships. In Model 2.5a and Model 2.5b, we repeated the test for interaction by family relationships in men and women in separate analyses (hypothesis 2.4). Association between bridge employment and depressive symptoms were investigated using proc surveyreg to account for loss to follow-up and within-subject correlation induced by the use of IPW weights. All statistical procedures were performed by using SAS 9.3 (SAS Institute, Cary, NC).

Results

Table 3.2 presents descriptive data on all variables included in our study at the baseline. At study entry, there were 4,468 participants: 2,788 retirees who do not engage in bridge employment and 1,680 retirees who engage in bridge employment. Those who engage in BE were on average 57.15 (SE 0.08) years old, with the retirement age of 61.68 years (SE 0.10). 56 percent of those who engage in BE were male, 13 percent were non-Hispanic white, with the average CESD summary score of 0.97 (SE 0.04) at the time of retirement. Results from the

MSMs for depression are listed in Table 3.3. Though not directly comparable to the results from MSMs, parameters from traditional repeated measures regression models were provided in Appendix 3.2, 3.3a, and 3.3b.

Table 3.3 presents the MSM estimates of Model 2.1 to Model 2.4 which test the association of bridge employment and depressive symptoms and the interactions by gender, income, and education in this association. Table 3.4 presents the MSM estimates of Model 2.5, Model 2.5a, and Model 2.5b – the interaction by family relationships in the association of BE and depressive symptoms, separately in men and women.

In Table 3.3, results from Model 2.1 indicate that those who engage in bridge employment report on average CESD scores of 0.223 units lower than those who do not (B= -0.223, 95% CI [-0.329, -0.117]). A unit increase in income at retirement and education was significantly associated with the lower CESD scores by 0.222 point (B= -0.222, 95% CI [-0.297, -0.148]) and 0.094 point scale (B= -0.094, 95% CI [-0.115, -0.073]), respectively. A unit increase in retirement age was associated with the lower CESD score by 0.018 (B= -0.018, 95% CI [-0.030, 0.005]). Men was found to have CESD score 0.285 points lower than women (B=-0.285, 95% CI [-0.390, -0.181]).

Model 2.2, 2.3, and 2.4 test if there is an interaction by gender, income, and education in the association of bridge employment and depressive symptoms, respectively. The estimates from the Model 2.2, 2.3, and 2.4 indicate that the effects of bridge employment on CESD do not vary by gender and income. On the other hand, education modified the association of bridge employment with depressive symptoms significantly (Model 2.4); Among those who engage in bridge employment, higher education was associated with more depressive symptoms (B=0.044, 95% CI [0.004, 0.084]). Model 2.5 tests the interaction by family relationships. The estimates for

the interactions are -0.553 (95% CI [-0.990, -0.115]), -0.071 (95% CI [-0.432, 0.290]), -0.331 (95% CI [-0.686, 0.024]) for first, second, and third category of family relationships, respectively, compared to the fourth category. Compared with those who have one or less living children and parents, those who have seven or more are associated with less depressive symptoms by 0.553 CESD scale (B= -0.553, 95% CI [-0.990, -0.115]). When analyzed separately by gender in Model 2.5a and 2.5b, we did not find any evidence that the association of bridge employment and depressive symptoms vary by different levels of family relationships among men. On the other hand, among women with seven or more living parents and children, bridge employment is associated with fewer depressive symptoms by 0.867 CESD scale compared to the women with one or less family relationship (B= -0.867, 95% CI [-1.506, -0.228]).

Discussion

By using marginal structural modeling, we explored a potential causal association between engaging in bridge employment and depressive symptoms. We used a marginal structural model approach as a solution to control for time-dependent confounders such as physical functioning disability, the number of medical conditions, years since retirement, and marital status. Such confounders behave simultaneously as confounders and intermediaries, which cannot be controlled by simply adjusting for those covariates as in traditional regression models. Moreover, we controlled for time-varying depressive symptoms prior to obtaining bridge employment to eliminate lagged effects of former depressive symptoms on bridge employment. Thus, the effects of bridge employment on depressive symptoms investigated in our models are immediate causal effects, assuming that there is no unmeasured confounding and the models being specified correctly.

As hypothesized, bridge employment was associated with less depressive symptoms in general (B=-0.223, 95% CI [-0.329, -0.117]]). Our findings are consistent with continuity theory. Older adults adapt to retirement by keeping a consistent life pattern, since exposure to unsafe and unstable environments are associated with persistent depressive symptoms (Fiske, Gatz, & Pedersen, 2003; Mojtabai & Olfson, 2004). Bridge employment provides a means to achieve continuity after retirement transition by allowing retirees to continue to work, and consequently, maintain their familiar life patterns and social networks (Beehr & Bennett, 2015; von Bonsdorff, Shultz, Leskinen, & Tansky, 2009). Contrary to our hypotheses, however, we found no evidence of modifying effects by income and gender. This results may imply that the main driver of post-retirement stress may be due to the loss of one's identity as a worker in our work-oriented society, regardless of one's socioeconomic position or financial state. Bridge employment may provide retirees with a means to preserve one's work role and maintain pre-retirement life pattern, which may protect retirees from sense of loss and instability and subsequent depressive symptoms. Moreover, the interaction effect by education in the association between bridge employment and education was significant but in the opposite direction from what was hypothesized; among those with bridge employment, higher education is associated with more depressive symptoms. Highly educated older adults may be more sensitive than the less-educated to perceived decline in age-related cognitive or physical ability or age discrimination which may exist in work places than the less-educated, which in turn, leads them to more stress and depressive symptoms.

We found that bridge employment have more beneficial effects on depressive symptoms among those who have more family relationships. When analyzed separately by gender (Table 2.4), we found that among women who have bridge employment, having seven or more living

parents and children is associated with less depressive symptoms compared to having one or less. These results are contrary to our hypothesis where we expected that those with many living family members may have more depressive symptoms due to the stress from financial or caregiving duty. This may be because women with many family members may have physical and emotional support from their family members who help them endure double-duty of working and caregiving. Another possibility is that they may have other family members who can share or take care of the caregiving duty other than themselves. While loneliness is associated with depression in elderly (Nolen-Hoeksema & Ahrens, 2002), older adults who have some living family members around may feel less lonely than those with only few, and thus, may be less prone to depressive symptoms (M E Szinovacz, DeViney, & Davey, 2001).

Strengths & Limitations

We provided novel insights to the research on mental health consequences of bridge employment in several ways. Our analyses may be the first to show the proximal effects of bridge employment on mental health using a longitudinal survey data over eleven survey waves. By using marginal structural models, we treated bridge employment as a time-varying exposure and recognized individuals engage in a bridge employment at different time points. Assuming no unmeasured confounder and correct model specification of our models, we were able to perform causal inference on the bridge employment effects on depressive symptoms with MSMs. Moreover, we were able to complement the current research gap by exploring how the association between bridge employment and post-retirement mental health may vary by socioeconomic status, gender, and family relationships. Our findings may be useful for policy implication to improve mental well-being of baby boomers who will be retiring and may engage in bridge employment in the increased numbers during the next few decades.

There are a number of caveats in our study. We used HRS core sample born between 1931 and 1940, and our results may not be completely generalizable to those who were born after 1940. The recent baby boomer generation who are starting to leave their career jobs (Beehr & Bennett, 2015) may be seeking bridge employment for different reasons than those of their older counterparts, which may result in different health consequences. Moreover, the definition of BE in this study involves only working for less than 10 years after retiring from one's career employment; it is possible that some subjects may have started employment but not have been able to be followed for 10 years until the last wave. In such respondents, it is not possible to distinguish true BE cases from unretirement cases including working full-time for more than 10 years after retirement, and as a result, the differences between the BE and comparison group may have been diluted in our results. Longer follow-up's may be required to refine the association between the BE and mental health.

In addition, people engaging in BE in our study are compared with those who do not engage in BE, including not only those completely retired but also those engaging in a career job or seeking BE after retirement. Broad comparison group may hinder clear understanding of the findings. Future studies should apply clearer eligibility criteria and more specific comparison groups. Analytically, the validity of our analysis and its causal interpretation depends on a few assumptions of the marginal structural model (Hernan, Brumback, & Robins, 2000). Lastly, as we truncated our MSM weights at 99^{th} percentile to increase precision, our results might have involved some bias due to the truncation (Cole & Hernan, 2008).

Conclusion

In this study, the potential mental health consequences of BE was addressed. This study was, to our knowledge, the first to investigate how this association may vary by SES and

gender. We found that BE in general is beneficial to depressive outcomes. Contrary to our hypotheses, BE was associated with more depressive symptoms in highly educated retirees. It was associated with less depressive symptoms in the retirees who have 7 or more living parents and children than in those with 1 or none; this association was especially strong in women when analyzed separately by gender.

However, a number of questions still remain unanswered. Future studies should explore the association between bridge employment and its mental health consequences in more recent generation of retirees. Investigating how the social mechanisms of the way bridge employment influences depression differs in relation with two closely related socioeconomic factors – income and education – may be also useful. Moreover, identifying systematic factors leading to gender differences in terms of modifying effect by family relationships in this association may help unlock many possibilities of targeted gender-specific interventions or policies. Given the lack of research regarding this topic, the results of this study provided many useful insights on the health consequences of BE.

Figure 3.1-1 Eligibility Criteria

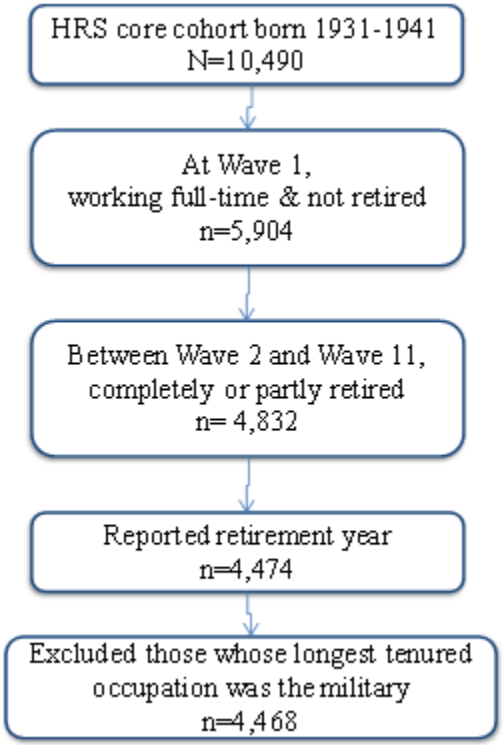


Figure 3.1-2 Eligibility Criteria for men women

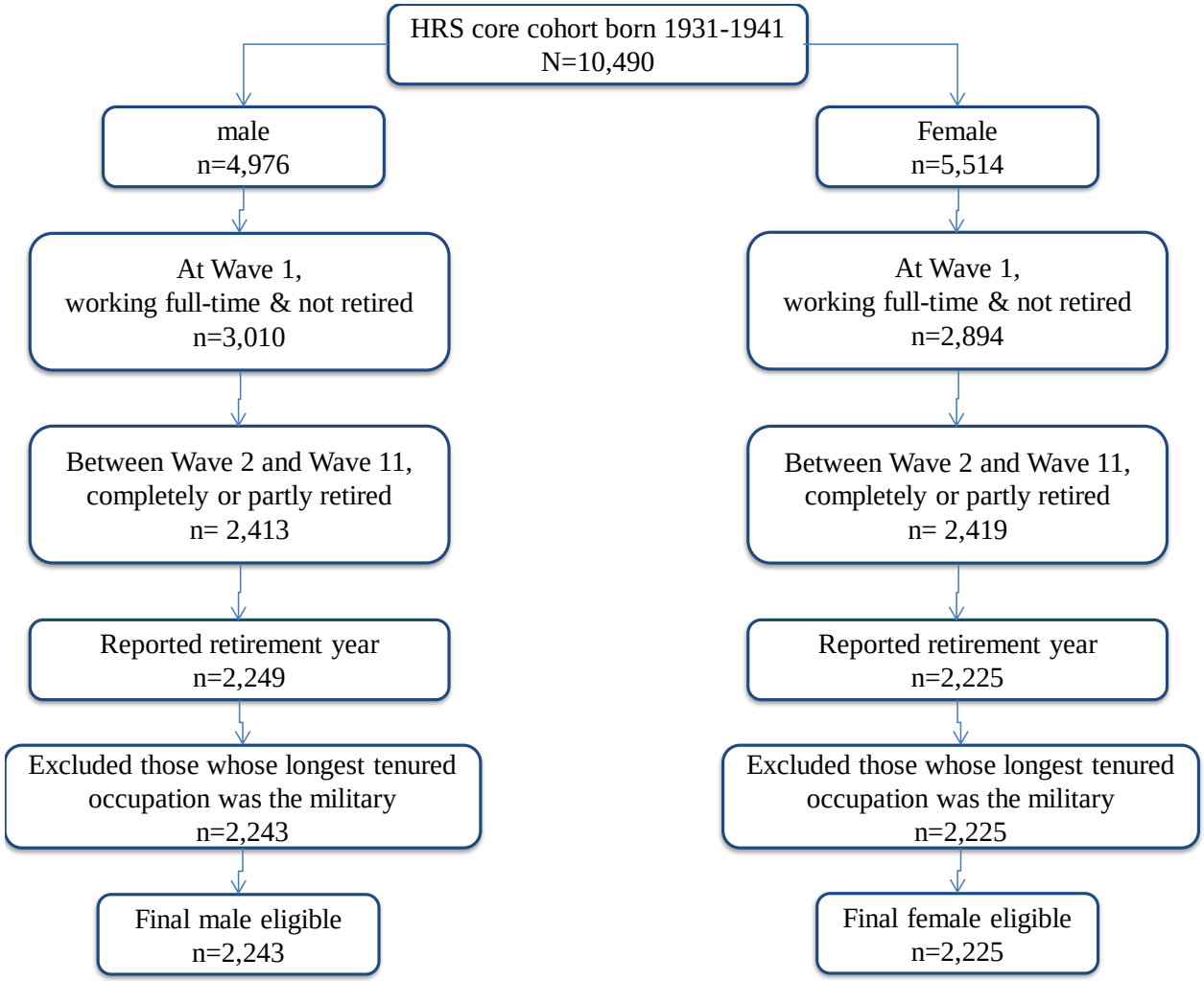


Figure 3.2-1 Definition of bridge employment

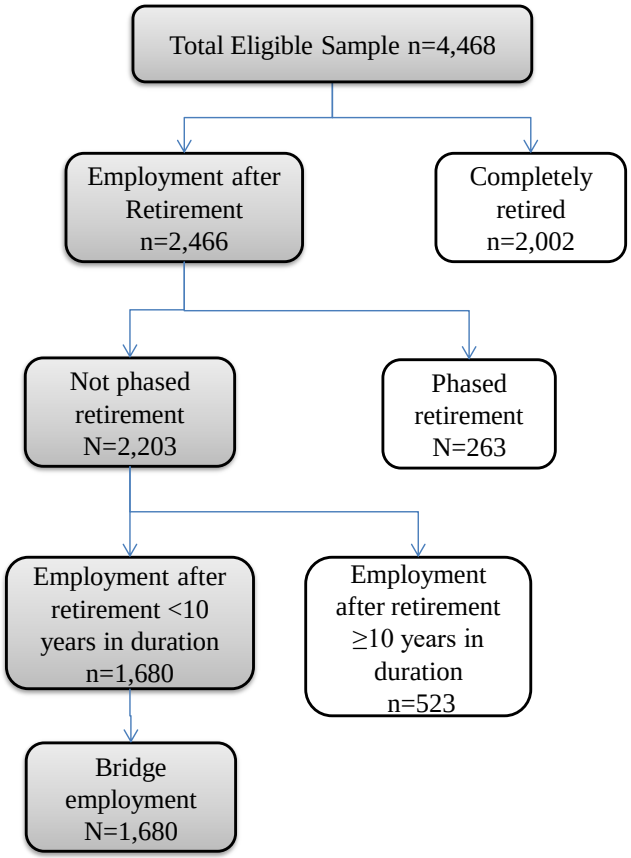


Figure 3.2-2 Definition of bridge employment, in men and women

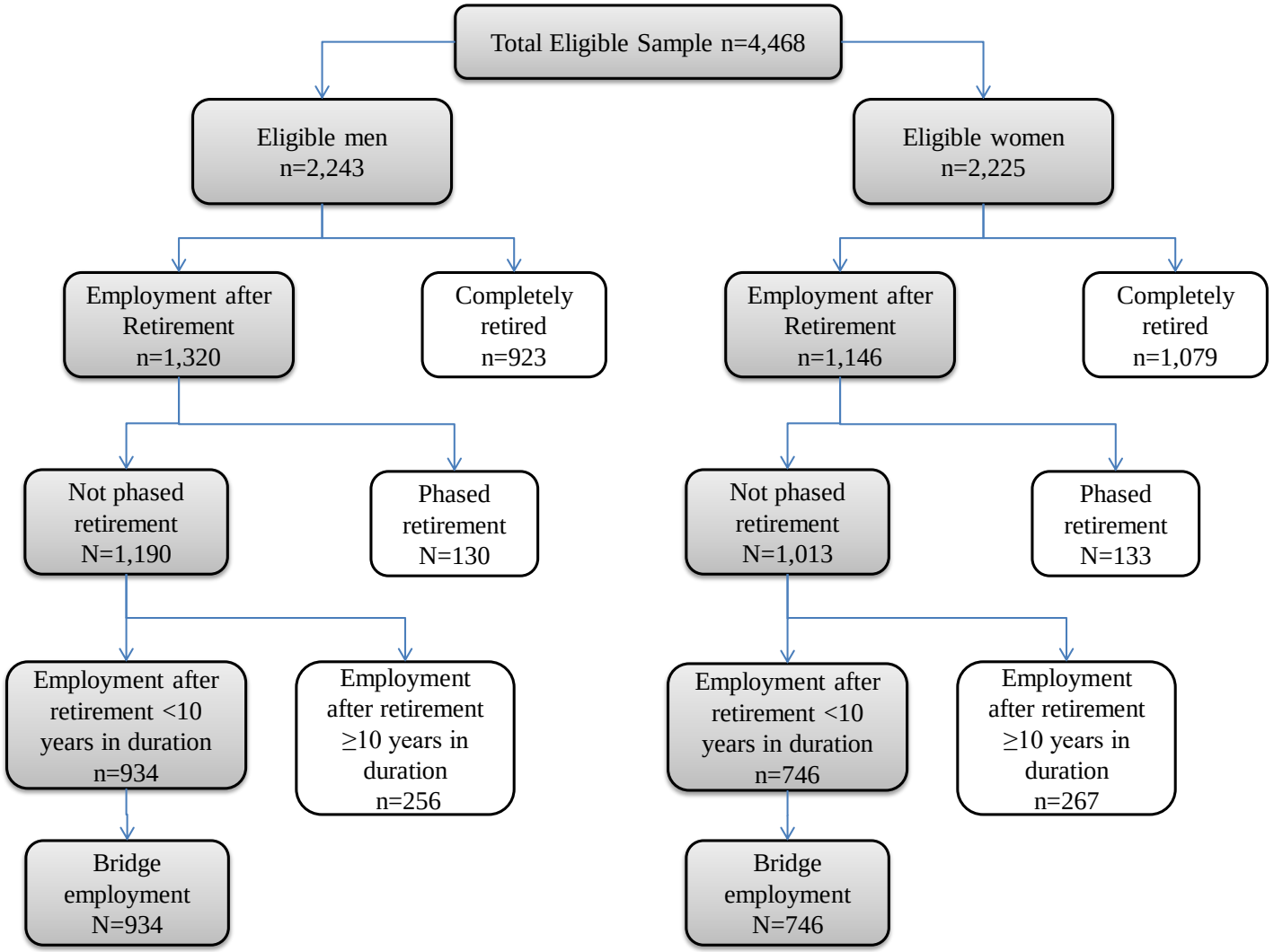


Figure 3.3 DAG for Time-varying confounding

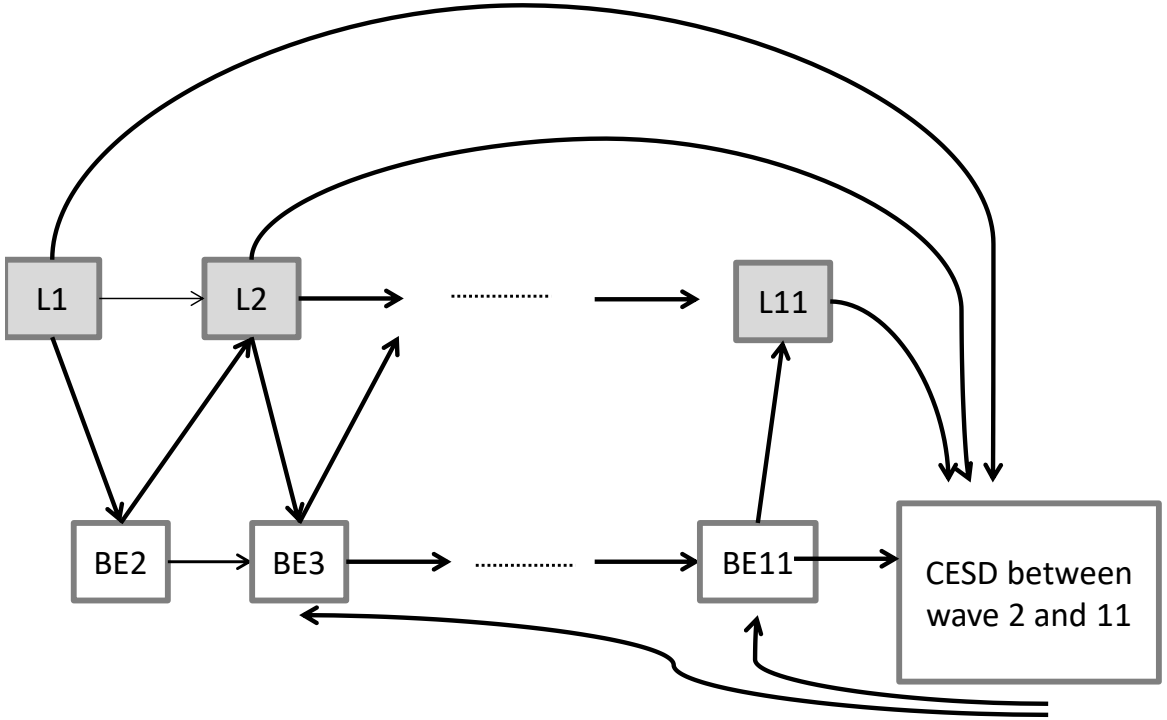


Table 3.1 Inverse Probability Weight Distribution by Year

Year	Mean	SD
1994	1.00	0.00
1996	1.01	0.22
1998	1.00	0.27
2000	1.00	0.28
2002	1.00	0.29
2004	0.99	0.29
2006	0.98	0.29
2008	0.97	0.29
2010	0.96	0.29
2012	0.95	0.29

Abbreviation: SD, standard deviation

Table 3.2 Baseline characteristics by bridge employment status, weighted by respondent-level sample weights, Health and retirement study

	Participants Not Engaging in Bridge Employment (n=2,788)	Participants Engaging in Bridge Employment (n=1,680)	Total (n=4,468)
Baseline Age (SE)	57.30 (0.06)	57.15 (0.08)	57.24(0.05)
Retirement Age (SE)	63.00 (0.09)	61.68 (0.10)	62.47(0.07)
Gender, %			
Female	52.31	44.22	49.23
Male	47.69	55.78	50.76
Race/Ethnicity,%			
White	13.44	12.61	13.13
Non-White	86.55	87.39	86.87
Household Income at Retirement (in $1,000) (SE)	0.11 (0.02)	0.15 (0.02)	0.13(0.01)
Education Years (SE)	12.61 (0.05)	13.01 (0.07)	12.80(0.04)
Marital Status, %			
Married/Partnered	72.89	74.92	73.66
Divorced/Separated/Widowed/Never married	27.11	25.08	26.33
Family (Number of Living Parents/Children) (SE)	3.68 (0.04)	3.92 (0.05)	3.77(0.04)
Medical Conditions Diagnosed at Retirement (SE)	1.39 (0.02)	1.12 (0.03)	1.29(0.02)
Physical Function Summary Score (SE)	1.93 (0.05)	1.66 (0.06)	1.82(0.04)
CESD Summary Score (SE)	1.13 (0.04)	0.97 (0.04)	1.06(0.03)

Abbreviations: SE, standard error

Table 3.3 Association between bridge employment and depressive symptoms by MSM

	Model 2.1		Model 2.2		Model 2.3		Model 2.4	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.800	[0.596, 1.004]	0.791	[0.581, 1.002]	0.799	[0.595, 1.003]	0.802	[0.598, 1.007]
Bridge employment (BE)	-0.223	[-0.329, -0.117]	-0.103	[-0.428, 0.221]	-0.235	[-0.345, -0.126]	-0.271	[-0.393, -0.149]
Retirement age	-0.018	[-0.030, -0.005]	-0.018	[-0.030, -0.005]	-0.018	[-0.030, -0.005]	-0.018	[-0.030, -0.005]
White race	0.097	[-0.049, 0.244]	0.097	[-0.050, 0.243]	0.097	[-0.050, 0.243]	0.097	[-0.050, 0.243]
Male	-0.285	[-0.390, -0.181]	-0.291	[-0.402, -0.181]	-0.286	[-0.390, -0.181]	-0.285	[-0.390. -0.181]
Income	-0.222	[-0.297, -0.148]	-0.222	[-0.297, -0.148]	-0.229	[-0.308, -0.151]	-0.222	[-0.297, -0.147]
Education	-0.094	[-0.115, -0.073]	-0.094	[-0.115, -0.073]	-0.094	[-0.115, -0.073]	-0.097	[-0.119, -0.076]
Family								
≥7	0.211	[-0.015, 0.437]	0.211	[-0.015, 0.437]	0.212	[-0.015, 0.438]	0.209	[-0.017, 0.436]
4-6	0.067	[-0.092, 0.226]	0.067	[-0.092, 0.225]	0.068	[-0.090, 0.227]	0.067	[-0.091, 0.226]
2-3	0.124	[-0.038, 0.287]	0.124	[-0.038, 0.287]	0.126	[-0.037, 0.288]	0.124	[-0.038, 0.286]
≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
BE*Male			-0.082	[-0.296, 0.132]				
BE*Income					0.097	[-0.022, 0.216]		
BE*Education							0.044	[0.004, 0.084]

Abbreviations: MSM, marginal structural model; CI, confidence interval; BE, Bridge employment

Note: All models are adjusted for covariates above, in addition to time-varying medical conditions, physical function disability, pre-BE depressive symptoms, years since retirement, marital status

Table 3.4 Association between bridge employment and depressive symptoms by MSM in men and women

	Model 2.5		Model 2.5b - *MEN*		Model 2.5b - *WOMEN*	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.785	[0.578, 0.993]	1.126	[0.945, 1.308]	1.310	[1.080, 1.539]
Bridge employment (BE)	-0.005	[-0.319, 0.310]	-0.052	[-0.442, 0.339]	0.035	[-0.464, 0.534]
Retirement age	-0.018	[-0.030, -0.005]	-0.013	[-0.029, 0.004]	-0.021	[-0.039, -0.002]
White race	0.095	[-0.052, 0.241]	0.050	[-0.142, 0.243]	0.123	[-0.085, 0.332]
Male	-0.286	[-0.390, -0.181]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Income	-0.222	[-0.298, -0.148]	-0.218	[-0.334, -0.102]	-0.225	[-0.320, -0.129]
Education	-0.094	[-0.115, -0.073]	-0.082	[-0.108, -0.056]	-0.111	[-0.145, -0.077]
Family						
≥7	0.251	[0.011, 0.491]	0.155	[-0.176, 0.487]	0.352	[0.007, 0.697]
4-6	0.071	[-0.096, 0.237]	0.028	[-0.183, 0.239]	0.107	[-0.147, 0.362]
2-3	0.147	[-0.024, 0.317]	0.050	[-0.168, 0.269]	0.233	[-0.024, 0.489]
≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
BE*Family						
BE* ≥7	-0.553	[-0.990, -0.115]	-0.282	[-0.873, 0.309]	-0.867	[-1.506, -0.228]
BE* 4-6	-0.071	[-0.432, 0.290]	-0.031	[-0.487, 0.426]	-0.103	[-0.668, 0.463]
BE* 2-3	-0.331	[-0.686, 0.024]	-0.242	[-0.687, 0.203]	-0.411	[-0.971, 0.149]
BE* ≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]

Abbreviations: MSM, marginal structural model; CI, confidence interval; BE, Bridge employment

Note: All models are adjusted for covariates above, in addition to time-varying medical conditions, physical function disability, pre-BE depressive symptoms, years since retirement, marital status

Appendix 3.1

Table 3.5 Decision rules used in recoding physical function limitation variables (Pool, 2016)

Participant Characteristics	Recoding Decision
Reports having an ADL limitation at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "fair" or "poor" self-rated health at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 2 or more chronic conditions at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 0-1 chronic conditions at time *t* and reported difficulty with a specific function at time *t-1*	The "Don't Do" response for the function that was previously reported as having some difficulty is recoded as 1: Some difficulty
Reports having some difficulty climbing one flight of stairs	The "Don't Do" response for climbing several flights of stairs is recoded as 1: Some difficulty
Reports having some difficulty walking across room	The "Don't Do" response for walking several blocks and walking one block are recoded as 1: Some difficulty
Reports having some difficulty walking one block	The "Don't Do" response for walking several blocks is recoded as 1: Some difficulty
Reports having any walking mobility difficulties	The "Don't Do" response and the other missing responses for jogging 1 mile are recoded as 1: Some difficulty
All other combinations of participant characteristics	"Don't Do" responses are recoded as 0: No difficulty

Appendix 3.2

Table 3.6 Association between bridge employment and depressive symptoms (Conventional regression models)

Association between bridge employment and depressive symptoms										
	Model 2.1		Model 2.2		Model 2.3		Model 2.4		Model 2.5	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.590	[0.470, 0.709]	0.590	[0.470, 0.710]	0.588	[0.469, 0.708]	0.587	[0.468, 0.707]	0.579	[0.456, 0.701]
Bridge employment (BE)	-0.070	[-0.156, 0.016]	-0.075	[-0.183, 0.033]	-0.054	[-0.147, 0.039]	-0.047	[-0.154, 0.059]	0.047	[-0.235, 0.328]
Retirement age	-0.017	[-0.025, -0.009]	-0.017	[-0.025, -0.009]	-0.017	[-0.025, -0.009]	-0.017	[-0.025, -0.009]	-0.017	[-0.024, -0.009]
White race	0.013	[-0.070, 0.096]	0.013	[-0.070, 0.096]	0.014	[-0.069, 0.097]	0.014	[-0.069, 0.097]	0.012	[-0.071, 0.095]
Female	-0.010	[-0.072, 0.053]	-0.011	[-0.077, 0.055]	-0.010	[-0.073, 0.052]	-0.010	[-0.072, 0.053]	-0.009	[-0.072, 0.054]
Income	-0.009	[-0.060, 0.042]	-0.009	[-0.060, 0.042]	-0.002	[-0.055, 0.052]	-0.009	[-0.060, 0.042]	-0.009	[-0.060, 0.042]
Education	-0.042	[-0.055, -0.029]	-0.042	[-0.055, -0.029]	-0.042	[-0.055, -0.029]	-0.040	[-0.053, -0.027]	-0.042	[-0.054, -0.029]
Family										
≥7	0.137	[0.011, 0.264]	0.137	[0.011, 0.264]	0.137	[0.011, 0.263]	0.139	[0.012, 0.265]	0.162	[0.027, 0.298]
4-6	0.099	[-0.005, 0.202]	0.099	[-0.005, 0.203]	0.098	[-0.005, 0.201]	0.099	[-0.004, 0.202]	0.101	[-0.009, 0.210]
2-3	0.117	[0.009, 0.224]	0.117	[0.009, 0.224]	0.116	[0.009, 0.224]	0.117	[0.010, 0.225]	0.134	[0.020, 0.248]
≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Married	-0.294	[-0.383, -0.204]	-0.294	[-0.383, -0.204]	-0.293	[-0.382, -0.203]	-0.294	[-0.383, -0.204]	-0.293	[-0.383, -0.204]
Years since retirement	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]
Medical Conditions	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]
Physical Function	0.084	[0.067, 0.102]	0.084	[0.067, 0.102]	0.084	[0.067, 0.102]	0.084	[0.066, 0.102]	0.084	[0.067, 0.102]
CESD	0.408	[0.376, 0.440]	0.408	[0.376, 0.440]	0.408	[0.376, 0.440]	0.408	[0.376, 0.440]	0.407	[0.375, 0.439]
BE*Female			0.011	[-0.162, 0.184]						
BE*Income					-0.079	[-0.179, 0.022]				
BE*Education							-0.019	[-0.054, 0.016]		
BE*Family										
BE* ≥7									-0.259	[-0.614, 0.097]
BE* 4-6									-0.034	[-0.353, 0.284]
BE* 2-3									-0.197	[-0.505, 0.111]
BE* ≤1									0.000	[0.000, 0.000]

Appendix 3.3a

Table 3.7 Association between bridge employment and depressive symptoms in *Men* (Conventional regression models)

Association between bridge employment and depressive symptoms in Men										
	Model 2.1m		Model 2.2m		Model2. 3m		Model2. 4m		Model 2.5m	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.590	[0.470, 0.709]	0.590	[0.470, 0.710]	0.613	[0.460, 0.766]	0.614	[0.461, 0.767]	0.597	[0.442, 0.752]
Bridge employment (BE)	-0.070	[-0.156, 0.016]	-0.075	[-0.183, 0.033]	-0.060	[-0.179, 0.058]	-0.074	[-0.202, 0.055]	0.119	[-0.304, 0.541]
Retirement age	-0.017	[-0.025, -0.009]	-0.017	[-0.025, -0.009]	-0.008	[-0.019, 0.003]	-0.008	[-0.019, 0.003]	-0.008	[-0.019, 0.004]
White race	0.013	[-0.070, 0.096]	0.013	[-0.070, 0.096]	0.049	[-0.080, 0.177]	0.049	[-0.079, 0.177]	0.048	[-0.081, 0.176]
Female	-0.010	[-0.072, 0.053]	-0.011	[-0.077, 0.055]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Income	-0.009	[-0.060, 0.042]	-0.009	[-0.060, 0.042]	-0.006	[-0.087, 0.074]	-0.010	[-0.086, 0.066]	-0.010	[-0.086, 0.066]
Education	-0.042	[-0.055, -0.029]	-0.042	[-0.055, -0.029]	-0.039	[-0.055, -0.022]	-0.039	[-0.057, -0.021]	-0.038	[-0.055, -0.021]
Family										
≥7	0.137	[0.011, 0.264]	0.137	[0.011, 0.264]	0.126	[-0.037, 0.289]	0.127	[-0.036, 0.290]	0.143	[-0.030, 0.315]
4-6	0.099	[-0.005, 0.202]	0.099	[-0.005, 0.203]	0.108	[-0.030, 0.245]	0.109	[-0.029, 0.246]	0.117	[-0.028, 0.261]
2-3	0.117	[0.009, 0.224]	0.117	[0.009, 0.224]	0.089	[-0.055, 0.233]	0.089	[-0.054, 0.233]	0.117	[-0.035, 0.269]
≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Married	-0.294	[-0.383, -0.204]	-0.294	[-0.383, -0.204]	-0.358	[-0.508, -0.207]	-0.359	[-0.510, -0.207]	-0.359	[-0.510, -0.207]
Years since retirement	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]	-0.016	[-0.024, -0.009]	-0.016	[-0.024, -0.009]	-0.016	[-0.024, -0.008]
Medical Conditions	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]	0.077	[0.042, 0.111]	0.077	[0.042, 0.111]	0.077	[0.042, 0.112]
Physical Function	0.084	[0.067, 0.102]	0.084	[0.067, 0.102]	0.083	[0.056, 0.109]	0.083	[0.056, 0.109]	0.083	[0.056, 0.109]
CESD	0.408	[0.376, 0.440]	0.408	[0.376, 0.440]	0.431	[0.381, 0.481]	0.431	[0.381, 0.481]	0.431	[0.381, 0.481]
BE*Female			0.011	[-0.162, 0.184]						
BE*Income					-0.042	[-0.177, 0.093]				
BE*Education							0.003	[-0.034, 0.040]		
BE*Family										
BE* ≥7									-0.189	[-0.718, 0.340]
BE* 4-6									-0.130	[-0.588, 0.328]
BE* 2-3									-0.303	[-0.751, 0.146]
BE* ≤1									0.000	[0.000, 0.000]

Appendix 3.3b

Table 3.8 Association between bridge employment and depressive symptoms in *Women* (Conventional regression models)

Association between bridge employment and depressive symptoms in Women										
	Model 2.1f		Model2. 2f		Model 2.3f		Model 2.4f		Model 2.5f	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.590	[0.470, 0.709]	0.590	[0.470, 0.710]	0.571	[0.400, 0.742]	0.568	[0.397, 0.739]	0.570	[0.391, 0.748]
Bridge employment (BE)	-0.070	[-0.156, 0.016]	-0.075	[-0.183, 0.033]	-0.050	[-0.197, 0.097]	-0.010	[-0.187, 0.168]	-0.020	[-0.390, 0.349]
Retirement age	-0.017	[-0.025, -0.009]	-0.017	[-0.025, -0.009]	-0.024	[-0.035, -0.013]	-0.024	[-0.035, -0.013]	-0.024	[-0.035, -0.013]
White race	0.013	[-0.070, 0.096]	0.013	[-0.070, 0.096]	-0.006	[-0.116, 0.104]	-0.007	[-0.117, 0.103]	-0.009	[-0.119, 0.101]
Female	-0.010	[-0.072, 0.053]	-0.011	[-0.077, 0.055]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Income	-0.009	[-0.060, 0.042]	-0.009	[-0.060, 0.042]	-0.004	[-0.063, 0.056]	-0.013	[-0.070, 0.044]	-0.013	[-0.070, 0.043]
Education	-0.042	[-0.055, -0.029]	-0.042	[-0.055, -0.029]	-0.043	[-0.062, -0.025]	-0.039	[-0.058, -0.020]	-0.043	[-0.062, -0.025]
Family										
≥7	0.137	[0.011, 0.264]	0.137	[0.011, 0.264]	0.166	[-0.029, 0.360]	0.164	[-0.031, 0.359]	0.200	[-0.012, 0.411]
4-6	0.099	[-0.005, 0.202]	0.099	[-0.005, 0.203]	0.097	[-0.060, 0.254]	0.099	[-0.059, 0.256]	0.092	[-0.075, 0.259]
2-3	0.117	[0.009, 0.224]	0.117	[0.009, 0.224]	0.155	[-0.005, 0.315]	0.157	[-0.003, 0.317]	0.162	[-0.009, 0.333]
≤1	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Married	-0.294	[-0.383, -0.204]	-0.294	[-0.383, -0.204]	-0.259	[-0.361, -0.156]	-0.260	[-0.362, -0.157]	-0.258	[-0.360, -0.155]
Years since retirement	-0.018	[-0.024, -0.012]	-0.018	[-0.024, -0.012]	-0.020	[-0.029, -0.011]	-0.020	[-0.029, -0.011]	-0.020	[-0.028, -0.011]
Medical Conditions	0.075	[0.048, 0.102]	0.075	[0.048, 0.102]	0.076	[0.035, 0.117]	0.076	[0.035, 0.118]	0.075	[0.034, 0.117]
Physical Function	0.084	[0.067, 0.102]	0.084	[0.067, 0.102]	0.086	[0.063, 0.110]	0.086	[0.062, 0.110]	0.086	[0.063, 0.110]
CESD	0.408	[0.376, 0.440]	0.408	[0.376, 0.440]	0.387	[0.347, 0.428]	0.387	[0.347, 0.428]	0.386	[0.346, 0.427]
BE*Female			0.011	[-0.162, 0.184]						
BE*Income					-0.109	[-0.254, 0.037]				
BE*Education							-0.053	[-0.118, 0.013]		
BE*Family										
BE* ≥7									-0.354	[-0.823, 0.114]
BE* 4-6									0.071	[-0.381, 0.524]
BE* 2-3									-0.090	[-0.511, 0.331]
BE* ≤1									0.000	[0.000, 0.000]

CHAPTER 4

Bridge Employment and Physical Health

Background

Physical impairment often leads to functional limitation and disability in older adults. Functional limitation refers to the loss of ability to perform tasks and obligations of usual roles and normal daily life, while disability is one's pattern of behavior which evolves with the functional limitation (Kelly-Hayes et al., 1992). Age-related functional limitation and disability, one of the common conditions of aging with a number of comorbidities, imposes a heavy burden on individual older adults as well as our society. First, functional limitation and disability leads to devastating outcomes for older adults. Loss of physical function and dependence on assistance in performing activities of daily living (ADLs) require hospitalization and extended hospital stays, which in turn, cause involuntary weight or muscle strength loss as well as low physical activity (Chou et al., 2012). Such consequences of functional loss may further cause poor quality of life in terms of physical, psychological, and social functions, and eventually lead to reduced longevity (Chou, Hwang, and Wu 2012; Reid & Fielding, 2012; Villareal et al. 2011). Moreover, it poses costly economic burden to our society. For instance, the economic burden of the loss of skeletal muscle mass leading to functional disability, was $18.5 billion or about 1.5 percent of total direct healthcare costs in the US in 2000 (Janssen, Shepard, Katzmarzyk, & Roubenoff, 2004). Furthermore, older persons who were functionally dependent accounted for 46% of the healthcare expenditures, but only made up 20% of the older adult population (Fried et al.,

2001). Additionally, they spent $5,000 more per year than people who remained independent (Pahor et al., 2014; G. Wang et al., 2004).

Our society is rapidly aging; as many as 76 million baby boomers born between the years 1946 and 1964 are retiring or planning to retire in the current and next decades. To cope with the economic implications of rapid population aging as well as aging-related diseases and disabilities, US government is planning to gradually raise retirement age eligible for Social Security benefits to age 67 by 2022 (Clarke et al., 2012). While such policy to raise official retirement age is widely approved by policy makers as a reasonable strategy to reduce economic burden of a government (Janssen et al., 2004), its potential health consequences for prospective retirees are largely unknown.

Retirement Effects on Physical Functioning

A number of recent studies have looked at the association between retirement and physical functioning, all of which found deteriorative retirement effects on physical functioning. Stenholm et al. found that physical functioning declines faster in retirement than in full-time work among employees aged 65 years or older (Stenholm et al., 2014). They also found that this association was not explained by absence of chronic diseases and lifestyle-related risks (Stenholm et al., 2014). Another study found that the complete retirement leads to 5-16 percent increase in difficulties associated with mobility and daily activities (Dave et al., 2008). Some studies explained this association of retirement on physical function decline by reduced physical activity following retirement (Chung et al., 2009; Slingerland et al., 2007). Retirement introduces a reduction in physical activity from work-related transportation that is not compensated for by an increase in sports participation or increase in non-sports leisure-time physical activity (Slingerland et al., 2007). Furthermore, Chung et al. found that physical activity decreased with

retirement from a physically demanding job but increased with retirement from a sedentary job (Chung et al., 2009). Lastly, involuntary retirement was associated with negative health consequences; a study using the Health and Retirement Study (HRS) found poorer physical functioning for workers who experience involuntary job loss (Gallo et al., 2000).

Change in Retirement Environment

In recent decades, however, the concept of retirement has become increasingly multifaceted (M. Wang & Shultz, 2010). Rather than a single event of permanent withdrawal from working life, retirement has developed into an individualistic and sometimes prolonged transition process (Barnett, Van Sluijs, and Ogilvie 2012; Wang and Shultz 2010; Maestas 2010). Indeed, only about a half of all workers go through a traditional retirement experience by abruptly ceasing all paid work in pursuit of a life of leisure and hobbies nowadays (Han & Moen, 1999; Maestas, 2010; Phyllis Moen et al., 2001a; R. L. Pleau, 2010; R. Pleau & Shauman, 2013). In the meantime, increasing number of retirees stay economically productive after retirement by engaging in bridge employment, which refers to a full-time or part-time job after retirement from one's full-time career job (Pleau and Shauman 2013; Pleau 2010).

Bridge Employment and Physical Functioning

Despite the increasing trend of bridge employment, there exists little systematic knowledge on its physical health consequences. Studies examining the consequences of bridge employment have largely focused on outcomes such as retirement adjustment and life satisfaction, which were found to be beneficial (Calvo et al., 2009; Choi, 2001; Kim & Feldman, 2000). To our current knowledge, there exists only one study which explicitly explored the association between bridge employment and physical functioning. Zhan, Wang, and Liu, in their 2009 study, showed that compared with full retirement, engaging in bridge employment either in

a career field or in a different field was associated with fewer functional limitations (Zhan et al., n.d.). Yet, no other study has specifically looked at the consequences of bridge employment in terms of physical functioning. This study aims to improve the current knowledge of the association between bridge employment and physical functioning by investigating the potential social mechanisms of this relationship. While the existing study simply examined if engaging in BE is associated with one's functional health, we additionally test potential modifying roles of financial status and occupation at the time of retirement in this association. Knowledge on the pathways of how bridge employment, or working after retirement, may influence physical functioning in older adults may be useful for developing social policies or interventions which may help delay functional loss and preserve independence among older adults. While more research should be done for policy implications, our study may be a stepping stone for future studies which investigate various pathways of bridge employment leading to either functional loss or improvement. Exploring the complex relationships between the retirement process and functional health is crucial for reducing medical costs as well as for enhancing individual independence and well-being, which is the major task of our aging society with rising medical bills.

Hypotheses Development

Previous research on the effects of physical activity on functional disability provides insights on the potential mechanism of direct effects of bridge employment on physical functioning. On the other hand, continuity theory emphasizes the smooth retirement adjustment through bridge employment as a strategy to preserve continuity post-retirement, which pertains to rather distal effects of bridge employment.

Continuity Theory

Continuity theory suggests that older adults attempt to preserve existing internal and external structures to avoid the experience of stressful disruption (Atchley, 1989). According to continuity theory, retirement is considered as stressful disruption which may result in the discontinuation of individuals' work role, routine life style, and financial stability. As long as older adults strategize to adapt to retirement transition and maintain their lifestyle, however, it is unlikely that they experience significant drop in health and wellbeing (Beehr & Bennett, 2015; Wang, 2007). Bridge employment is considered as a strategy to preserve the existing external structure in one's lifestyle after retirement transition. Via engagement in bridge employment, retirees continue to work and maintain their familiar life patterns and social networks (Beehr & Bennett, 2015; von Bonsdorff, Shultz, Leskinen, & Tansky, 2009), which may help them continue with physically and socially active life styles. This strategy to continue pre-retirement life style may lead to a relief from the instability and anxiety due to the role loss and financial strain. Such mental stability assisted by bridge employment may eventually lead to benefits related to physical functioning such as delayed functional loss. Therefore, continuity theory suggests a rather long-term or distal influence of bridge employment on physical functioning through creation of mental stability.

Furthermore, retirees with high income and high education may experience more beneficial effects of bridge employment on physical functioning than those with low income and low education. While retirees of low-socioeconomic status may obtain bridge employment to replenish their financial resources to maintain their pre-retirement living standards, retirees with high socioeconomic status (SES) may have chosen to work after retirement because of the satisfaction and enjoyment that their work life provides them with. Thus, they would be free from the consideration of financial strain, which is associated with persistent depressive

symptoms (Fiske, Gatz, & Pedersen, 2003; Mojtabai & Olfson, 2004). Since depression often leads to physical disability (Hamer, Bates, & Mishra, 2011; Lenze et al., 2001), those who engage in bridge employment mainly out of financial needs may develop depressive symptoms, which may lead to functional disability. Thus, the benefits of bridge employment on physical functioning may be larger in high-SES group than in low-SES group.

Benefits of Physical Activities on Physical Functioning

On the other hand, the proposed mechanism of bridge employment effects on physical functioning through physical activities is a proximal one. Studies have demonstrated a beneficial dose-response pattern for physical activity associated with a lower risk of functional limitations (Pahor et al., 2014). Some previous studies blamed reduced or lack of exercise following one's retirement as one of the major factors influencing the deteriorative effects of retirement on physical functioning (Chung et el.). Bridge employment, by providing an opportunity to resume work-related physical activities in retirement, may play a beneficial role in physical functioning among older adults. Physically demanding occupations such as blue collar jobs may induce more physical activities through bridge employment; relatively sedentary occupations such as white-collar jobs may not generate much physical activities through working. Therefore, the beneficial effects of bridge employment on physical functioning via physical activities may be maximized in physically intense blue-collar jobs, rather than in white-collar jobs.

Aims & Hypotheses

We aim to investigate the effects of bridge employment on physical functioning and how these associations are modified by income, education, and occupational status.

Aim 3-1

Investigate the association between bridge employment and physical functioning

Hypothesis 3-1

Bridge employment is associated with fewer physical functioning disabilities.

Aim 3-2

Investigate if pre-retirement occupation modifies the association between bridge employment and physical functioning

Hypothesis 3-2

White collar or sedentary pre-retirement occupations, compared to blue collar or physically demanding occupations, are associated with less beneficial effect of bridge employment on physical functioning.

Aim 3-3

Investigate if income and education modifies the association between bridge employment and physical functioning

Hypothesis 3-3

High education and high income increase the beneficial effect of bridge employment on physical functioning .

Methods

Data source: Health and Retirement Studies (HRS)

The Health and Retirement Study (HRS) is a nationally representative longitudinal survey of more than 37,000 individuals over age 50 in 23,000 households in the US (Sonnega et al., 2014). HRS provides data on the changing health and economic circumstances associated with ageing at both individual and population levels by focusing on four broad areas: income and wealth; health, cognition and use of healthcare services; work and retirement; and family connections (Juster & Suzman, 1995; Sonnega et al., 2014). HRS includes eligible spouses as

respondents and oversamples blacks, Hispanics, and residents of Florida (Juster & Suzman, 1995). For the purpose of this study, we used the RAND files (version N) of HRS data, which was prepared by the RAND Center for the Study of Aging with support from Social Security Administration (SSA) and National Institute of Aging (NIA).

Eligibility criteria

Figure 4.1 describes the eligibility criteria for the purpose of this study. This study uses HRS core cohort of the Health and Retirement Study, who were born between 1931 and 1941. The total size of the HRS core cohort classified by birth year is n=10,490, including 4,976 males and 5,514 females.

Of all HRS core respondents, we focused on those employed at the first survey and eligible to go through retirement process to take a fully prospective approach. We did not include those who were retired years ago prior to wave 1 to exclude those who were retired early (n=5,904, (3,010 males and 2,894 females)).

Then, respondents, who reported working full-time, were followed from wave 2 to wave 11 to identify the time of retirement. Once a person retires, he or she becomes eligible for our analyses. Among 5,904 males and females who were working and not retired at wave 1, we excluded those who were not retired between wave 2 and wave 11. We included only those who reported as completely or partly retired between waves 2 and 11 and also reported the year of retirement (n= 4,474 (2,249 males and 2,225 females)).

Finally, we excluded those whose longest tenured occupation was the military (n=6) since military careers are unique in their patterns of retirement, which yielded our final sample with 4,468 males and females (2,243 males and 2,225 females).

Outcome variable: Physical Functioning

Physical functioning was the summary score of the answers to a series of questions asking the respondent if he/she has any difficulty performing a certain function. The functions being asked included running or jogging a mile; walking several blocks; walking one block; sitting for about 2 hours; getting up from a chair; climbing several flights of stairs; climbing one flight of stairs; stooping, kneeling, or crouching; extending arms above shoulders; pushing or pulling large objects; lifting or carrying over 10 pounds; picking up a dime from the table; walking across a room; getting in and out of bed; bathing; dressing; and eating (Chien, Campbell, Hayden, Hurd, Main, Mallett, Martin, Meijer, Moldoff, Rohwedder, & Clair, 2014). Participants were told to exclude any difficulties expected to last less than three months. The response options include yes (some difficulty); no (no difficulty); can't do; and don't do. The answers to the physical functioning questions were coded so that 1 representing "can't do" or "yes" (some difficulty) and 0 representing "no." While "don't do" responses were coded as missing, some of them were recoded to minimize the potential bias following the strategy that Pool used in her 2016 study (Appendix 4.1). A person may not do the function because he or she cannot do the function without difficulty, which may underestimate the final summary score where missing responses are added as the score 0 (Pool, 2016). The final physical functioning summary score ranges from 0 to 17, with 0 being no limitation and 17 being the highest degree of limitation.

Primary predictor variable: Bridge Employment

The primary predictor variable for Aim 3 is bridge employment. A number of studies on bridge employment define it as simply "employment following a full-time career job," (Adams & Beehr, 2003; Beehr & Bennett, 2015; Cahill et al., 2006). Yet more detailed definition is necessary, given that retirement process being so diverse. For the purpose of this study, we

defined bridge employment as participation in the labor force for less than 10 years for an employer different from his or her career, after declaring retirement from one's full-time career employment, regardless of the length of time an individual is out of the labor force after retirement (Figure 4.2). We excluded potential "phased retirement" from our bridge employment by excluding work for the same employer as one's long-term employer. Phased retirement, which means gradual reduction of work with a long-term employer as an older employee approaches full retirement (Cahill et al., 2006; Chen & Scott, 2006), may differ from other bridge employment in terms of its motivation and consequences. Moreover, we followed Feldman and excluded employment for 10 years or more after one's retirement from our definition of bridge employment. Bridge employment for 10 years or more would most likely be the employment after early retirement, which is strongly associated with poor health prior to retirement (Feldman, 1994) and may differ in its effects on health from the regular retirement. Thus, we decided that including it may not be appropriate in our study where we predict the health outcome. After following our definition, we identified 934 men (42%) and 746 women (34%) out of 2,243 men and 2,225 women eligible for our study.

Covariates

Pre-retirement occupation

Pre-retirement occupation was first categorized into five categories – white collar, skilled service, unskilled service, blue collar, and military. After military occupation was omitted due to its unique pattern of retirement (Pleau 2010), we used a four-category pre-retirement occupation variable categorized into white collar, high-skilled service, low-skilled service, and blue-collar occupations. The specific classification based on the HRS coding of occupation from the 2000 Standard Occupational Codes (SOCs) is shown in Table 4.1.

Income

Total household income was the sum of all income in a household, which included the respondent's and spouse's individual earnings, employer pension or annuity, Social Security income, individual unemployment or workers' compensation, food stamps, household capital income as well as alimony, insurance, and inheritance. Total household income was log-transformed and centered at the median value and included as a continuous, time-invariant variable at the baseline, which in this case was the time at one's retirement.

Education

Education, originally a continuous variable representing the number of years of education (range 0-18), was categorized for the purpose of this study into four categories including less than 12 years, 12 years, 13 to 16 years, and more than 16 years.

Other predictors

Demographic variables such as participants' age at retirement and race/ethnicity were included as time-invariant covariates. Race/ethnicity was a binary variable with 1 representing White/Caucasian and 0 representing all others. Other time-varying covariates included the number of years since retirement and two distinct health variables: the number of medical conditions and physical function disability.

The number of medical conditions was the summary score of the answers to a series of questions asking the respondent if a doctor has ever diagnosed him/her with certain medical conditions. The conditions are high blood pressure or hypertension; diabetes or high blood sugar; cancer or a malignant tumor of any kind except skin cancer; chronic lung disease except asthma such as chronic bronchitis or emphysema; heart attack, coronary heart disease, angina,

congestive heart failure, or other heart problems; stroke or transient ischemic attack (TIA); emotional, nervous, or psychiatric problems; and arthritis or rheumatism (range 0-8).

Depressive symptoms were measured by an eight-item CESD scale. This scale was shortened from a 20-item mental health scale (Radloff, 1977). The scale asks if a respondent felt depressed; felt activities were efforts; slept restlessly; was happy; felt lonely; felt sad; could not get going; enjoyed life 'much of the time' during the week preceding the interview. Six of the eight items indicate the presence of certain negative mental health states and two items indicate certain positive mental health status. While responses are scored in yes/no (1/0), negative items were reverse-coded so that the summary score would range from 0 to 8. The higher values of the scale indicate fewer depressive symptoms, or better mental health.

Physical activity is the measure of how frequent a respondent exercise. Because the questions were worded differently at each wave, the measures were somewhat inconsistent across the waves. Only the "vigorous physical activity" variable was available for all 11 waves, and it was included in our study with modification. From wave 1 to 6, the question asks if the respondent participates in vigorous physical activity 3 times a week or more with the answer choices of yes/no. From wave 7 to 11, the question asks how often a respondent participates in vigorous physical activity; and its answer choices included occurring every day; more than once per week; one to three times per month; or never. In need of consistency throughout the 11 waves to be included in our model, we slightly changed the question for wave 7 to 11. The question for 7 to 11 will ask if a respondent exercise vigorously twice a week or more, with answer choices of yes/no. Despite the inconsistency of the question for wave 1-6 and 7-11, the distribution of the answers was relatively consistent throughout the waves, which convinced us

that it should not be a major source of misclassification bias. The modification strategy for physical activity variable is listed in Appendix 4.2.

Statistical Analyses

Marginal Structural Models (MSMs)

While a number of previous studies established that individual health status is a major determinant of bridge employment, there is a potential bidirectional relationship between bridge employment and physical functioning disability which may bias our estimates. Since time-varying covariates such as the number of medical conditions act as confounders and mediators at the same time, which may lead to over-adjustment of estimates by traditional regression approach (Robins et al., 2000), statistical models which account for the time-varying covariate patterns are necessary to yield proper causal estimates. We used marginal structural models (MSMs) which involve using inverse probability weights to account for such time-dependent confounding.

The hypothesized direct acyclic graph (DAG) (Figure 4.3) demonstrates time-dependent confounding in our study. For instance, CESD (time-varying confounder, L_t) at wave t predicts both one's bridge employment (exposure, BE_{t+1}) in the wave (t+1) and physical functioning (outcome) between the wave 2 and 11. L_{t+1} may behaves as a mediator as well; BE_{t+1} may predict the depressive symptoms (L_{t+1}), which in turn, may predict one's physical functioning.

Moreover, we controlled for time-varying physical functioning prior to obtaining bridge employment to control for the effects of physical functioning on the subsequent wave of bridge employment; those with good physical functioning status are more likely to engage in bridge employment, yet such effects should be controlled to prevent endogeneity bias in our study.

Inverse probability of exposure weights (IPW)

In a marginal structural model approach, counterfactual models were fit to a pseudo-population constructed by inverse probability weights (Hernán et al., 2000). The inverse probability of exposure weights (IPW) were formed based on the ratio of conditional probability densities of engaging in bridge employment (Cole & Hernan, 2008; Robins, Hernan, & Brumback, 2000). Probability densities were conditional on baseline and time-varying values of the potential confounders (Brumback, Hernán, Haneuse, & Robins, 2004; Hernán et al., 2000). The numerator is the probability that the subject did not engage in bridge employment, conditional on past history of bridge employment and baseline (time-invariant) covariates, while the denominator is the probability that the subject did not engage in bridge employment at time k, given past history of bridge employment as well as time-invariant and time-dependent covariates. Weighting by stabilized IPW weights creates a pseudo population that controls for measured time-varying confounding (Hajat et al., 2011), which enables causal estimation of the association between bridge employment and physical functioning disability. We trimmed our stabilized IPW weights for final MSM models because our stabilized weight included very large values, which may imply a misspecified weighting model (Cole & Hernán, 2008). Once we trimmed weights at 1st and 99th percentile, they resulted in means close to 1 and narrower range of values. The means and standard deviations of truncated IPW by year are listed in Table 4.2. The final weight for each wave was the product of the HRS survey weights and truncated IPW. The final weights were used in the MSMs to investigate the association between bridge employment and physical function disability. All statistical procedures were performed by using SAS 9.3 (SAS Institute, Cary, NC).

Model 3.1 tested overall effects of bridge employment on physical function (hypothesis 3.1). Model 3.2 tested the interaction effects of pre-retirement occupation in the association

between bridge employment and physical function (hypothesis 3.2). Model 3.3 and Model 3.4 tested the interaction effects of education and income, respectively, in the association between bridge employment and physical function disability (hypothesis 3.3). Regression estimates were obtained by using proc surveyreg to account for loss to follow-up and within-subject correlation induced by the use of IPWe weights. All statistical procedures were performed by using SAS 9.3 (SAS Institute, Cary, NC).

Results

Table 4.3 presents descriptive data on all variables included in our study at the baseline. At study entry, there were 4,468 participants: 2,788 retirees who do not engage in bridge employment and 1,680 retirees who engage in bridge employment. Those who engage in BE were on average 57.1 (SD 0.08) years old, with the retirement age of 61.7 years (SD 0.10). 56 percent of those who engage in BE were male, 13 percent were non-Hispanic white, with the average physical function disability summary score of 1.7 (SD 0.06) at the time of retirement.

Results from the marginal structural models for physical functioning are listed in Table 4.3. As described above, MSMs provide population estimates that are counterfactual, and thus not directly comparable to the parameters from traditional repeated measures regression models which provide conditional estimates. Results of traditional regression models are also presented in Appendix 4.2.

Results from the Model 3.1 indicate that those who engage in bridge employment report on average 0.126 point higher physical function disability score than those who do not engage in bridge employment (95% CI [-0.001, 0.252]). Men reported physical function disability scores of 0.578 points lower than women (95% CI [-0.723, -0.433]). Compared to those who had less-than-high school (<12 years) education, those graduated from high school, graduated from

college or more, and those in between (13 to 16 years) reported lower physical function disability score by 0.326, 0.249, and 0.357 points, respectively. A unit increase in income at the time of retirement was significantly associated with the lower physical function disability score by 0.192 points.

Compared to those who had blue collar pre-retirement occupations, the effects of bridge employment on physical functioning did not vary significantly in those who had white collar (B=-0.138, 95% CI [-0.450, 0.174]), high-skilled service (B=0.167, 95% CI [-0.318, 0.653]), and low-skilled service pre-retirement occupations (B= -0.228, 95% CI [-0.598, 0.141]) (Model 3.2). The association between bridge employment on physical functioning did not differ significantly for those who graduated from high school (12 years) (B=-0.238, 95% CI [-0.718, 0.242]), those who graduated from college or more (>16) (B= -0.259, 95% CI [-0.658, 0.140]), and those in between (13 to 16 years) (B= -0.264, 95% CI [-0.667, 0.138]), when compared to those who had less-than-high school education (<12 years). Though not significant, our results suggest that the BE effects on functional disability may be stronger among those with less than 12 years of education and those with blue collar pre-retirement occupations. Lastly, we found no interaction by income as well (B=-0.092, 95% CI [-0.240, 0.157]) in the association of bridge employment with physical functioning.

Discussion

This study investigated the association between bridge employment and physical functioning. Contrary to our hypothesis which expected the beneficial effects of bridge employment on physical functioning, we found that in general, bridge employment is marginally associated with decline in functional health. Moreover, we did not find the association between bridge employment and physical functioning vary by pre-retirement occupation, income, and

education. One possible speculation on the deteriorative effects on bridge employment pertains to biological aging of older adults. Aging is associated with loss in muscle mass, change in bone composition, and decreased strength in functional capacity (Evans & Campbell, 1993; Shephard, 1999). Retirees, while engaging in bridge employment, may have to perform a task which may be beyond their physical capacity, become manifested by worker fatigue or develop increased susceptibility to musculoskeletal injuries, heart attacks, and strokes (Evans and Campbell 1993), all of which have the consequence of reduced or loss of physical function.

We found that the bridge employment effect on physical functioning is deteriorative, rather than beneficial, regardless of occupational categories. As mentioned above, due to the decreased functional capacity with aging, performing physically intensive tasks as in blue collar occupations beyond one's capacity may deteriorate physical function. On the other hand, white collar or sedentary occupation may discourage even the necessary minimal amount of physical activity, which may be deteriorative to physical functioning as well. Numerous studies suggest that functional impairment and disability can be prevented or postponed by the exercise of sufficient frequency, intensity, and duration (Shephard 1999), yet such effort may not be feasible in a work setting. Moreover, longer interval would have been needed in our models to observe the proposed distal effects of bridge employment on physical functioning via mental relief.

Strengths, Limitations, and Future Research

Due to the potential bidirectional association between bridge employment and physical function, we used MSM approach by applying inverse probability weighting for each wave to adjust for factors that may simultaneously act as confounders and mediators, which has enabled causal inference in our model. Due to the long duration of the follow-up including repeated measurement of variables, this study was able to investigate this association over more

than twenty years. However, the causal inference of our analysis depends on MSM assumptions including the correct specification of the model and no unmeasured confounding (Hernan et al., 2000). We truncated our MSM weights for the proper model specification and increase in precision, yet this may have generated bias in our final estimates. Moreover, we were limited in our ability to address cohort differences, since we only used the HRS core sample born between 1931 and 1940. Due to the strong secular trends in retirement process, examining cohort differences in the effects of bridge employment on physical functioning among older adults would be useful. Moreover, some of the variables such as physical functioning and physical activity were included in the model after slight modification, which may have generated bias in our results. In addition, this study may be subject to exclusion bias. While the definition of BE in this study includes only those who work for less than 10 years after career employment, it is probable that some subjects may have started employment but not yet been followed for 10 years until the end of the study. We are not aware if such subjects may stop working before reaching 10 years, and it may cause bias in our study. It is not possible to distinguish between BE and unretirement including working full-time for more than 10 years, and therefore, the differences between BE and comparison group may have been diluted in our results. Longer follow-up's will be required to refine this association between BE and physical health. Furthermore, we compare people engaging in BE with those not engaging in BE in our study. However, people not engaging in BE may include many different situations such as being completely retired, engaging in a career job, or seeking BE after retirement. Such broad comparison group may interfere clear understanding of the findings. Future studies should set up more specific eligibility criteria and comparison groups for clearer understanding of the analyses.

Conclusion

Using eleven waves of Health and Retirement Study from the year 1992 to 2012, we assessed the effects of bridge employment on physical functioning among older adults. To explore the social mechanism of this association, we tested the interactions by pre-retirement occupation and basic socioeconomic status. We found that bridge employment is marginally associated with negative consequences of physical functioning in older adults, and this association is not modified by the pre-retirement occupation, education, and income at the time of retirement.

As the retirement processes of older adults are becoming multifaceted and as more retirees engage in bridge employment before they are fully retired, it is crucial to explore how bridge employment influences elderly health. Physical functioning is especially important in older adults because losing physical functioning means losing independence, which results in tremendous social costs related to it. By investigating the association between bridge employment and its consequences regarding physical functioning, this study provided an insight to how to shape cost-effective policies which may assist with smooth retirement transition, delay functioning loss, and preserve independence among older adults in our rapidly aging society.

Figure 4.1 Eligibility Criteria

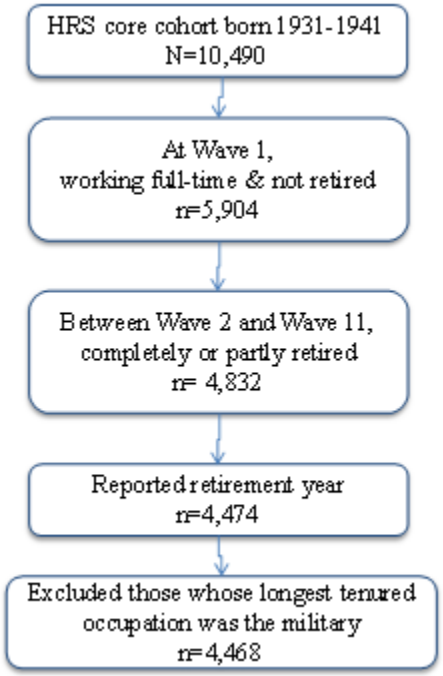


Figure 4.2 Definition of Bridge Employment

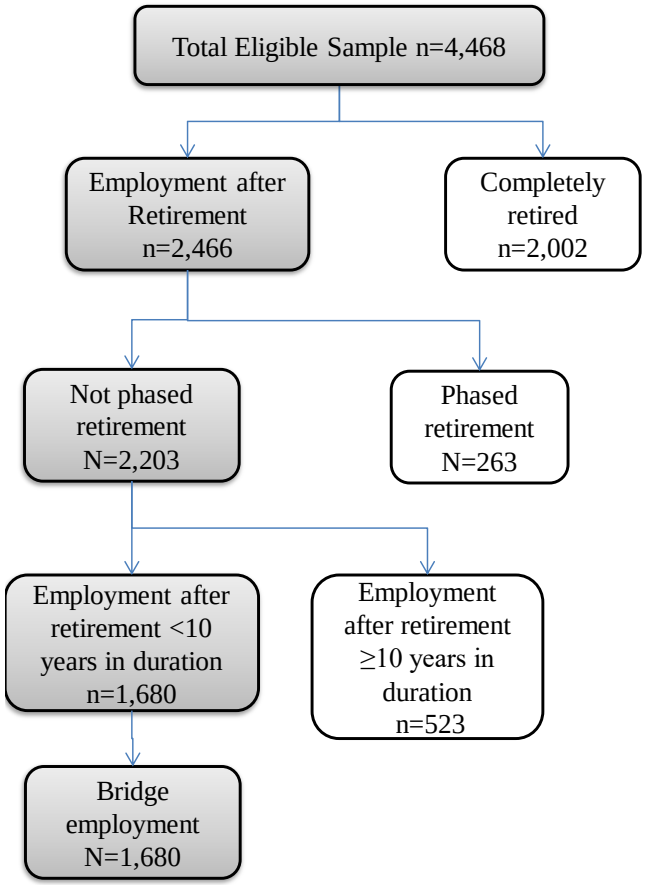


Figure 4.3 DAG for Time-varying confounding

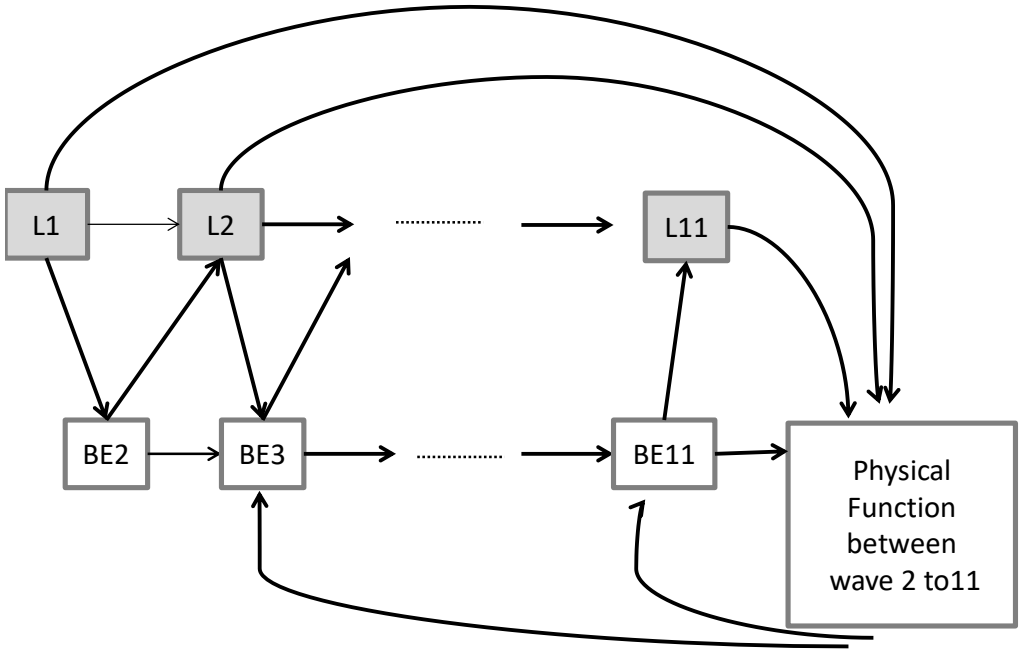


Table 4.1 Classification of Occupation Categories based on the HRS coding (from the 2000 Standard Occupational Codes (SOCs))

White collar	Management occupation
	Business operations special
	Financial specialists
	Computer and math occupations
	Architecture and engineering
	Life physical social sciences
	Legal occupations education training library arts design entertainment occupations
	Sales occupations
High-skilled service	Community social services occupations
	Healthcare practices and technicians
	Protective services occupations
	Food prep and serving occupations
Low-skilled service	Building grounds clean maintenance
	Personal care and service occupations
	Office and administrative support occupations
Blue collar	Farm fish forestry occupations
	Construction trades
	Extraction workers
	Install maintenance repair workers
	Production occupations
	Transport material moving
Military	Military specific occupations

Table 4.2 Inverse Probability Weight Distribution by Year		
Year	**Mean**	**SD**
1994	1.00	0.00
1996	1.00	0.10
1998	1.00	0.13
2000	1.00	0.16
2002	1.00	0.18
2004	1.00	0.21
2006	1.01	0.23
2008	1.01	0.26
2010	1.02	0.29
2012	1.02	0.33

Abbreviation: SD, standard deviation

Table 4.3 Baseline characteristics by bridge employment status, weighted by respondent-level sample weights, Health and retirement study

	Participants Not Engaging in Bridge Employment (n=2,788)	Participants Engaging in Bridge Employment (n=1,680)	Total (n=4,468)
Baseline Age (SE)	57.30 (0.06)	57.15 (0.08)	57.24(0.05)
Retirement Age (SE)	63.00 (0.09)	61.68 (0.10)	62.47(0.07)
Gender, %			
Female	52.31	44.22	49.23
Male	47.69	55.78	50.76
Race/Ethnicity,%			
White	13.44	12.61	13.13
Non-White	86.55	87.39	86.87
Household Income at Retirement (in $1,000) (SE)	0.11 (0.02)	0.15 (0.02)	0.13(0.01)
Education Years, %			
>16 years	12.11	14.08	12.86
13-16 years	28.92	32.35	30.22
12 years	37.10	36.49	36.87
<12 years	21.88	17.08	20.06
Occupation, %			
White collar	41.31	42.92	41.99
High-skilled service	7.30	7.47	7.37
Low-skilled service	25.33	23.82	24.69
Blue collr	26.06	25.79	25.95
Marital Status, %			
Married/Partnered	72.89	74.92	73.66
Divorced/Separated/Widowed/Never married	27.11	25.08	26.33
Medical Conditions Diagnosed at Retirement (SE)	1.39 (0.02)	1.12 (0.03)	1.29(0.02)
Physical Function Summary Score (SE)	1.93 (0.05)	1.66 (0.06)	1.82(0.04)
CESD Summary Score (SE)	1.13 (0.04)	0.97 (0.04)	1.06(0.03)

Abbreviations: SE, standard error

Table 4.4 Association between bridge employment and depressive symptoms by MSM

	Model 3.1		Model 3.2		Model 3.3		Model 3.4	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	2.674	[2.442, 2.905]	2.645	[2.397, 2.892]	2.598	[2.333, 2.864]	2.668	[2.436, 2.900]
Bridge employment (BE)	0.126	[-0.001, 0.252]	0.232	[-0.019, 0.482]	0.345	[0.002, 0.688]	0.149	[0.015, 0.284]
Retirement age	0.003	[-0.013, 0.020]	0.003	[-0.013, 0.020]	0.003	[-0.013, 0.020]	0.003	[-0.013, 0.020]
White	0.014	[-0.182, 0.211]	0.012	[-0.184, 0.209]	0.022	[-0.175, 0.220]	0.018	[-0.179, 0.216]
Male	-0.578	[-0.723, -0.433]	-0.582	[-0.727, -0.437]	-0.576	[-0.721, -0.431]	-0.578	[-0.723, -0.433]
Education								
>16yrs	-0.326	[-0.604, -0.048]	-0.335	[-0.615, -0.056]	-0.239	[-0.564, 0.086]	-0.325	[-0.604, -0.047]
13-16yrs	-0.357	[-0.583, -0.131]	-0.368	[-0.595, -0.141]	-0.259	[-0.541, 0.023]	-0.359	[-0.585, -0.133]
12 yrs	-0.249	[-0.465, -0.032]	-0.262	[-0.479, -0.046]	-0.154	[-0.428, 0.120]	-0.253	[-0.469, -0.038]
<12yrs	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Income	-0.192	[-0.275, -0.109]	-0.191	[-0.274, -0.108]	-0.192	[-0.275, -0.109]	-0.156	[-0.258, -0.054]
Occupation								
White collar	-0.163	[-0.350, 0.024]	-0.107	[-0.341, 0.126]	-0.169	[-0.356, 0.018]	-0.164	[-0.351, 0.022]
Skilled service	-0.226	[-0.495, 0.043]	-0.309	[-0.642, 0.024]	-0.225	[-0.494, 0.044]	-0.230	[-0.499, 0.038]
Low-skill service	-0.131	[-0.346, 0.085]	-0.040	[-0.312, 0.232]	-0.136	[-0.352, 0.079]	-0.130	[-0.345, 0.085]
Blue collar	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
BE*Occupation								
BE*White collar			-0.138	[-0.450, 0.174]				
BE*Skilled service			0.167	[-0.318, 0.653]				
BE*Low-skill service			-0.228	[-0.598, 0.141]				
BE*Blue collar			0.000	[0.000, 0.000]				
BE*Education								
BE* >16yrs					-0.238	[-0.718, 0.242]		
BE*13-16yrs					-0.264	[-0.667, 0.138]		
BE* 12 yrs					-0.259	[-0.658, 0.140]		
BE* <12yrs					0.000	[0.000, 0.000]		
BE*Income							-0.092	[-0.240, 0.057]

Abbreviations: MSM, marginal structural model; CI, confidence interval; BE, Bridge employment

Note: All models are adjusted for covariates above, in addition to time-varying depressive symptoms, medical conditions, pre-BE physical function disability, marital status, years since retirement, and physical activity

Appendix 4.1

Table 4.5 Decision Rules Used in the Recoding of Physical Function Limitation Variables

Participant Characteristics	Recoding Decision
Reports having an ADL limitation at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "fair" or "poor" self-rated health at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 2 or more chronic conditions at time *t*	All "Don't Do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 0-1 chronic conditions at time *t* and reported difficulty with a specific function at time *t-1*	The "Don't Do" response for the function that was previously reported as having some difficulty is recoded as 1: Some difficulty
Reports having some difficulty climbing one flight of stairs	The "Don't Do" response for climbing several flights of stairs is recoded as 1: Some difficulty
Reports having some difficulty walking across room	The "Don't Do" response for walking several blocks and walking one block are recoded as 1: Some difficulty
Reports having some difficulty walking one block	The "Don't Do" response for walking several blocks is recoded as 1: Some difficulty
Reports having any walking mobility difficulties	The "Don't Do" response and the other missing responses for jogging 1 mile are recoded as 1: Some difficulty
All other combinations of participant characteristics	"Don't Do" responses are recoded as 0: No difficulty

Appendix 4.2

Table 4.6 Modification procedure of the “physical activity” variable

Wave	1 -6	7 - 11	7 - 11
	Original	Original	Modified
Question	Do you participate in vigorous physical activity 3 times a week or more ?	Do you participate in vigorous physical activity once a week or more ?	How often do you participate in vigorous physical activity?
Answer	1.Yes 0.No	1.occurring everyday 2. > 1 per week 3. 1-3 times per month 4. < 1 per month 5. Never	1.Yes 0.No

Percentage of those who reply "1. Yes" to the physcial activity question each wave after modification of the question for wave 7-11

Wave	No BE	BE
1	20	20
2	21	25
3	53	58
4	50	55
5	49	54
6	47	52
7	26	31
8	24	31
9	24	29
10	24	25
11	24	26

Appendix 4.3

Table 4.7 Association between bridge employment and physical function disability (Conventional regression models)

Association between bridge employment and physical function disability										
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept	0.813	[0.682, 0.944]	0.818	[0.684, 0.951]	0.786	[0.649, 0.924]	0.790	[0.651, 0.928]	0.809	[0.677, 0.940]
Bridge employment (BE)	-0.006	[-0.064, 0.051]	-0.016	[-0.107, 0.075]	0.073	[-0.038, 0.185]	0.105	[-0.051, 0.261]	0.005	[-0.057, 0.066]
Retirement age	0.007	[-0.001, 0.015]	0.007	[-0.001, 0.015]	0.007	[-0.001, 0.015]	0.007	[-0.002, 0.015]	0.007	[-0.001, 0.015]
White	-0.036	[-0.138, 0.067]	-0.036	[-0.139, 0.067]	-0.038	[-0.140, 0.065]	-0.053	[-0.142, 0.035]	-0.034	[-0.137, 0.069]
Male	-0.209	[-0.275, -0.143]	-0.216	[-0.299, -0.134]	-0.211	[-0.277, -0.144]	-0.199	[-0.261, -0.136]	-0.209	[-0.275, -0.143]
Education										
>16yrs	-0.084	[-0.206, 0.038]	-0.084	[-0.206, 0.038]	-0.092	[-0.214, 0.030]	-0.007	[-0.145, 0.130]	-0.084	[-0.206, 0.037]
13-16yrs	-0.080	[-0.181, 0.020]	-0.081	[-0.181, 0.020]	-0.089	[-0.190, 0.012]	-0.035	[-0.155, 0.085]	-0.081	[-0.182, 0.019]
12 yrs	-0.074	[-0.169, 0.022]	-0.074	[-0.170, 0.021]	-0.083	[-0.179, 0.012]	-0.032	[-0.149, 0.086]	-0.075	[-0.171, 0.020]
<12yrs	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
Income	-0.075	[-0.113, -0.037]	-0.075	[-0.113, -0.037]	-0.075	[-0.113, -0.037]	-0.074	[-0.111, -0.037]	-0.059	[-0.108, -0.010]
Occupation										
White collar	-0.062	[-0.147, 0.023]	-0.062	[-0.147, 0.023]	-0.007	[-0.115, 0.100]	-0.061	[-0.142, 0.019]	-0.063	[-0.148, 0.022]
Skilled service	-0.050	[-0.179, 0.079]	-0.050	[-0.179, 0.079]	-0.090	[-0.255, 0.074]	-0.067	[-0.190, 0.056]	-0.051	[-0.180, 0.078]
Low-skill service	-0.037	[-0.131, 0.057]	-0.037	[-0.131, 0.057]	0.016	[-0.108, 0.139]	-0.012	[-0.101, 0.077]	-0.037	[-0.131, 0.057]
Blue collar	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]	0.000	[0.000, 0.000]
CESD	0.067	[0.043, 0.091]	0.067	[0.043, 0.091]	0.067	[0.043, 0.091]	0.054	[0.031, 0.077]	0.067	[0.043, 0.091]
Medical conditions	0.212	[0.184, 0.239]	0.212	[0.184, 0.239]	0.211	[0.184, 0.239]	0.215	[0.187, 0.242]	0.211	[0.184, 0.239]
Physical function	0.553	[0.527, 0.579]	0.553	[0.527, 0.579]	0.553	[0.526, 0.579]	0.550	[0.525, 0.576]	0.553	[0.527, 0.579]
Years since retirement	-0.002	[-0.007, 0.004]	-0.001	[-0.007, 0.004]	-0.001	[-0.007, 0.004]	-0.001	[-0.007, 0.005]	-0.001	[-0.007, 0.004]
Married	0.054	[-0.020, 0.128]	0.054	[-0.021, 0.128]	0.053	[-0.021, 0.128]	0.029	[-0.041, 0.100]	0.055	[-0.019, 0.130]
Physical activity	-0.130	[-0.184, -0.076]	-0.130	[-0.185, -0.076]	-0.131	[-0.185, -0.077]	-0.138	[-0.191, -0.086]	-0.130	[-0.184, -0.076]
BE*Male			0.018	[-0.098, 0.134]						
BE*Occupation										
BE*White collar					-0.122	[-0.260, 0.017]				
BE*Skilled service					0.093	[-0.155, 0.341]				
BE*Low-skill service					-0.120	[-0.288, 0.048]				
BE*Blue collar					0.000	[0.000, 0.000]				
BE*Education										
BE* >16yrs							-0.181	[-0.378, 0.016]		
BE*13-16yrs							-0.123	[-0.303, 0.057]		
BE* 12 yrs							-0.106	[-0.286, 0.074]		
BE* <12yrs							0.000	[0.000, 0.000]		
BE*Income									-0.039	[-0.106, 0.028]

CHAPTER 5

Discussion

Summary

This project examined the determinants of bridge employment and its effects on mental and physical health, using the eleven waves of Health and Retirement Study (HRS). We addressed potential bidirectional causation and time-dependent confounding which may influence observed associations between bridge employment and health by applying appropriate study designs and statistical methods.

In Chapter 2, important determinants of bridge employment in retired men and women were identified by using generalized estimating equation (GEE). We found that in men and women, engagement in bridge employment was positively affected by good health, younger retirement age, and shorter years since retirement. In gender-specific analyses, we found some distinct determinants of BE in men and women. Education, which represents early-life socioeconomic status, was found to be the main driver for men's bridge employment, and marital status as well as having a lot of family relationships was found to be a strong determinant of women's bridge employment. These results, however, should be evaluated with a caution. While the gender-stratified analyses were motivated by the social role theory which suggested distinct social patterns leading to BE in men and women, this approach precludes more definitive statement s on the statistical robustness of gender differences in the determinants of BE and health consequences of BE. In Chapter 3, we used a marginal structural models (MSMs) to estimate the association between bridge employment and depressive symptoms, and found that

BE was associated with fewer depressive symptoms. While the association between bridge employment and depressive symptoms did not differ by income and gender, we found that bridge employment may be less beneficial for mental health among those highly educated. Moreover, BE was found to be more beneficial on mental health among women who have a number of family relationships than those who only have few. In Chapter 4, we estimated the effect of bridge employment on physical functioning by using MSMs. Bridge employment was associated with a higher physical function disability score, or more functional disabilities. The association, however, did not differ by pre-retirement occupation, education, and income.

Differential effects of bridge employment on depression and physical functioning

Depression and physical functioning are closely related and are known to influence each other in the same direction (Russo et al., 2007; Stegenga et al., 2012). Our hypotheses in Aim2 and Aim3, therefore, expected that bridge employment would benefit both mental and physical health. However, we found that bridge employment has a deteriorative effect on physical functioning, while it is beneficial to depression. One speculation is that bridge employment may provide mental relief to those retirees who are worried about the role loss and instability due to a sudden change in their lifestyles, yet it may not be a source of enjoyment. Such mental relief may improve depressive symptoms among retirees by enabling them to continue with the lifestyle similar to that prior to retirement, yet it may not be enough to have them recover from physical fatigue or tiredness from working. Tiredness or fatigue in old age often result in physical impairment which lead to functional loss (Ettinger Jr. et al., 1994; Faulkner, Larkin, Claflin, & Brooks, 2007). While bridge employment may provide relief and stability during retirees' role loss and sudden change in life style, those who engage in bridge employment may

be subject to other elements leading to physical complications which can deteriorate physical functioning.

While this study is first to investigate the mechanism of this difference of bridge employment effects on mental and physical health, our findings may be informative for policy considerations such as Social Security and Medicare. While there are gradual ongoing increases in retirement age for Social Security, the association between bridge employment and functional decline should not be overlooked. Future research should identify major modifiers of the association between bridge employment with mental and physical health to develop targeted retirement policies for those who are especially vulnerable for functional loss.

Application of Alternative Analytical Methods

The use of an alternative analytical method other than the traditional regression method can better address the complex nature of the relationship between bridge employment and health. The comparison between the estimates from the alternative analytical method and the traditional method may help better understand the utility and complications of employing non-traditional methods in statistical analyses.

In Chapter 3 and Chapter 4, we used marginal structural models (MSMs) to investigate the associations of bridge employment with mental and physical health outcomes. The advantage of using MSMs is that it controls for time-varying confounding through inverse probability weights (IPW). In Chapter 3, MSM was used to address time-varying confounding such as time-varying medical conditions, which act as confounding by predicting both bridge employment of subsequent wave (exposure) and depressive symptoms (outcome), as well as mediator between the bridge employment of the same wave and depressive symptoms (Figure 3.3). Moreover, MSM also addresses the potential bidirectional association. In Chapter 3, depressive symptoms

(outcome) may affect whether or not to engage in bridge employment (subsequent exposure), which should be controlled for to minimize bias. Similarly, in Chapter 4, we used MSM to address the issue of time-dependent confounding by major time-varying health variables such as medical conditions and depressive symptoms, as well as the bidirectional association between time-varying bridge employment and time-varying physical functioning (Figure 4.3). In both Chapter 3 and 4, IPW weights adjust for time-varying covariates that potentially confound the association between bridge employment (exposure) and health (outcomes) without over-adjusting for the potentially mediating outcome-related changes that may exist on the pathway from bridge employment to mental and physical health. In Chapter 3, the estimate produced by MSM for the association of bridge employment with depressive symptoms is within 68% of the traditional regression estimates. The value of the estimate was highly attenuated in the traditional model; there may be strong mediation effects by time-varying confounders which mediate the association between bridge employment and depressive symptoms.

However, there are some caveats of the MSM approach as well. The MSM approach requires specification of the exposure model to estimate IPW weights and the outcome model to estimate the association between the exposure and the outcome, and thus, is affected by correct model specification. Moreover, MSM estimates tend to have larger standard errors, which affect the precision of estimates. Lastly, we could not test the effect modification with potential time-varying confounders in the association of bridge employment with health due to a covariable adjustment approach in MSM. Despite some caveats and complications related to using MSMs, they are considered as appropriate analytical models for causal inference. Thus, MSMs may be especially useful to investigate research questions in social epidemiology where the exposure

cannot be randomized into treatment and control groups, as in the topic of this paper where engagement in bridge employment cannot be randomized.

Overall findings and Future Recommendations

This project attempts to investigate major determinants and consequences of bridge employment, one of the popular retirement processes among older Americans. The first aim discovers why older adults who retire from their career jobs are motivated to engage in bridge employment. Then, the second and third aims investigate how such choices to work after retirement affect retirees' mental and physical health. Different motivations for BE may result in distinct health consequences; based on the social role theory, continuity theory, and previous relevant studies, we tested if one's SES, occupational categories, and family relationships, which we have found to be associated with engagement in BE, modify BE effects on mental and physical health. However, many of our results differ from our hypotheses. We found that highly-educated women are more likely than low-educated women to engage in BE, yet those who are highly-educated benefit less from BE in terms of mental health. Men with median education are more likely to obtain bridge employment than those with high or low education, while those with high education are found to benefit less from bridge employment. Moreover, women with a number of extended family relationships are more likely to engage in BE, and obtain more mental health benefits from BE than those who have only few or no family relationship. None of the potential modifiers of the association between BE and functional health were found to be significant. While our discussion in each chapter may provide few snapshots of social pathways of antecedents and health consequences of BE, more studies are necessary for the comprehensive understanding of BE and its health effects. For example, while our hypotheses about women's double duty may deteriorate mental health was reversed in our actual results, the role of working

status of the spouse as well as retiree's marital status in the association of BE and health should be further investigated; loneliness, rather than the socially expected caregiving duty, may be a major modifier in BE effects on mental health. In terms of functional health, testing the role of actual specific physical exercises including work-related activities in the association of BE and physical functioning may be useful. Moreover, our study examined those who engage in BE, compared with those who do not engage in BE, including many different statuses such as currently seeking BE, participating in a career employment, and completely retired and not seeking BE. We recommend that future studies should have more specific categorization of comparison groups which may lead to the discovery of the association which may have been masked in our analyses.

Bridge Employment, Pro-work Policies, and Post-retirement Health

Using the continuity theory, we conceptualized retirement as an adjustment process in this dissertation through which retirees get used to the changed aspects of life in the transition from working to non-working states (Mo Wang & Shultz, 2009). While retirement is viewed as a longitudinal development process characterized by adjustment, retirees' health, fiscal, and psychological well-being can be viewed as indicators of their level of adjustment in such retirement process (Maximiliane E. Szinovacz, 2003; Mo Wang, 2007). Bridge employment provides continuity in terms of a work role, social connections, and financial security, and therefore, helps retirees properly adjust to retirement process, which theoretically may be beneficial for post-retirement health in general.

Pro-work policies have been established as the potential solutions to resolve problems generated by sky-rocketing health care costs as well as rapidly aging society. They promote bridge employment or other forms of post-retirement employment as well as late retirement by

reducing early retirement incentives, increasing post-retirement financial burden for retirees, and providing more opportunities for post-retirement employment.

However, it is worth noting that important antecedents of health in retirement include gender, SES, and financial planning activities before retirement (K. E. Cahill et al., 2006; Hershey, Henkens, & Van Dalen, 2007; Reitzes, Mutran, & Fernandez, 1996). As mentioned in previous chapters, women's retirement income are typically lower than men's due to the discontinuous career paths and their social gender roles (Glass & Kilpatrick, 1998). Income and education influence retirees' fiscal well-being through their influence on retirees' pre-retirement financial status and access to additional income sources in retirement (Mo Wang, 2007). Moreover, increased financial planning activities before retirement have been repeatedly documented to lead to better financial well-being (Hershey et al., 2007; Reitzes et al., 1996; Taylor & Shore, 1995). Furthermore, health and SES influence each other to a significant extent. Retirees' health problems have important implications for their financial well-being due to high levels of healthcare costs, while retiree's fiscal well-being is related to retiree's life quality such as nutritional intake and living conditions and healthcare quality (Mo Wang, 2012), which in turn affects health status.

To truly maximize the health benefits of BE and efficiently manage the government spending for increasing number of the nation's older adults, therefore, the pro-work policies to encourage older adults to engage in BE or work longer may not be enough. Gender-specific programs to support disadvantaged women such as those with discontinuous career trajectories as well as intense efforts to educate potential retirees about post-retirement financial planning are urgently needed to reduce health care costs and disparities in SES among retirees in this aging society.

Strengths and Limitations

This dissertation uses the HRS core cohort from the Health and Retirement Study (HRS) in its all three aims. It is a large, nationally representative sample of individuals over age 50 with more than 20 years of follow-up (Sonnega et al., 2014). The use of HRS core cohort was a big strength of our study as well. It is a relatively recent cohort with the most extensive longitudinal data over 11 waves of biennial survey. Moreover, the retirement processes of HRS core respondents were influenced by the beginning of recent pro-work government policies. In addition, HRS core women have been at the center of social role confusion when more women started to become well-educated and delimit themselves from the traditional role of housewives. Therefore, our study was able to investigate the determinants and health effects of bridge employment at the transition of retirement environment as well as dramatic increase in women's rights. Methodologically, we performed separate analyses for men and women (Aim1 & 2) to account for fundamental gender differences in retirement processes, career trajectories, and social roles over the life course. In terms of statistical analyses, our longitudinal analyses in Aim1 accounted for correlated data structure due to repeated measurements in HRS by using weighted Generalized Estimating Equation (GEE). In Aim 2 and Aim 3, we used marginal structural models (MSMs) to control for the potential bidirectional association between bridge employment and health. The MSM also minimizes the potential reverse causality, and thus enables careful causal inference regarding the effect of bridge employment on health.

On the other hand, there are some caveats to our study. Our use of the HRS core sample born between 1931 and 1940 and may not be generalizable to those who were born after 1940. Moreover, this study did not specifically exclude those who retired early. Determinants of bridge employment among early retirees may differ from these who retired at or after the retirement age.

Thus bias related to misclassification may have altered the results of this study. Moreover, the average income and education levels have increased over more than 20 years of follow-up, which may have biased our results. Lastly, while we attempted causal inference by using MSM approach, our results were subject to the fulfillment of MSM assumptions of no unmeasured confounders and correct model specifications.

Conclusion

This dissertation identifies the determinants of bridge employment in men and women and addresses its mental and physical health consequences. Results indicate that in men and women, engagement in bridge employment was positively affected by good health, younger retirement age, and shorter years since retirement. Education was found to be the main driver for men's bridge employment, and marital status was a strong determinant of women's bridge employment. While bridge employment was associated with fewer depressive symptoms, it was associated with more functional disabilities. Moreover, the associations of bridge employment with depressive symptoms and physical functioning did not vary by socioeconomic status and gender. One exception we found was the association between BE with fewer depressive symptoms among women with more family relationships.

This study provided novel insights to the mechanism of retirement process and its influence on mental and physical health. As increasing numbers of baby boomers retiring and seeking bridge employment in the coming decades, understanding why older Americans choose to remain working later in life and how working beyond retirement affects elderly health is the key for the government and employers to utilize the rich pool of experienced workers who are willing to work beyond career employment. This study should be a stepping stone for many future studies which investigate the social mechanisms connecting diverse retirement processes

and post-retirement health, which may be applied to retirement policies and health interventions to enhance older adults' well-being and save budget for the future government.

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