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# The cumulative influences of socioeconomic status on health outcomes in late adulthood: A latent growth curve analysis

Kyung Hwa Kwag  
*Iowa State University*

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**The cumulative influences of socioeconomic status on health outcomes in late adulthood:  
A latent growth curve analysis**

by

**Kyung Hwa Kwag**

A dissertation submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of  
DOCTOR OF PHILOSOPHY

Major: Human Development and Family Studies (Child Development)

Program of Study Committee:  
Jacques Lempers, Major Professor  
Peter Martin  
Brenda Lohman  
Daniel Russell  
K. A. S. Wickrama

Iowa State University

Ames, Iowa

2009

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## ABSTRACT

The objectives of this study were to examine a) the cumulative influences of demographic variables as well as socioeconomic status on trajectories of physical limitations, chronic diseases, and depressive symptoms, and b) cross-domain associations of these health problems in late adulthood. This study used the data ( $N = 4,374$ , age > 65 years) from the Health and Retirement Study (HRS), collected biennially during the period from 1998 to 2006. The results of this study indicated that SES was confounded with demographic factors, especially ethnicity/race, because most of the influences of demographic factors and ethnicity/race on health problem trajectories diminished when SES was accounted for. The results of latent growth curve analyses demonstrated long-term influences of socioeconomic status on a) the levels (severity), and b) the slopes (rates of change) in health problem trajectories during old adulthood. Graphical analyses revealed that the SES influences on slopes reflect a) the diverging trajectories in physical limitations reflecting a cumulative influence of SES and b) the persistent trajectories in depressive symptoms reflecting a parallelism in old age. In addition, the initial level of a health problem influenced the change in another health problem over time, supporting the notion of a stress-manifestation or health proliferation process over late adult years. Overall, the results showed that health problems progress over the later adulthood years as an inter-related dynamic process influenced by SES. By understanding differential influences of SES on different health outcomes in old age and the dynamic health process during this period, better health interventions and prevention programs can effectively be formulated and implemented for older adults.

## CHAPTER 1. INTRODUCTION

### *Importance of the Present Study*

Public policy programs such as Healthy People 2010 have been issued to eliminate health disparities in the United States (U.S. Department of Health and Human Services, 2000). The goals of Healthy People 2010 are to advance the quality and length of life with better health and to eliminate health disparities related to age, gender, ethnicity/race, or socioeconomic status (U.S. Department of Health and Human Services, 2000). In conjunction with substantial evidence for the effects of gender (Denton, Prus, & Walters, 2004; Gorman & Read, 2006; Read & Gorman, 2006), marital status (Bennett, 2006; Williams & Umberson, 2004) and ethnicity/race (Cagney, Browning, & Wen, 2005; Kelley-Moore & Ferraro, 2004; Liao, McGee, Cao, & Cooper, 1999) in health status, there are a number of studies documenting the effects of socioeconomic position in health status (Clack, Stump, Miller, & Long, 2007; Lantz et al., 2001; Phelan et al., 2004; Wray, Alwin, McCammon, Manning, & Best, 2006). Despite these long-term efforts to eliminate health disparities, recent studies have shown that health inequalities has been widening in the United States (Kelley-Moore, 2006; Warren & Hernandez, 2007). Therefore, the present study primarily explores the influences of socioeconomic status on health disparities with an examination of ethnic/racial and demographic characteristics.

A number of studies have exerted plentiful efforts to explore the manner in which ethnicity/race and demographic characteristics as well as socioeconomic status influence health disparities (Aneshensel, 1992; Cockerham, 2005; Grzywacz et al., 2004; Herd, Goesling, & House, 2007; Mirowsky & Ross, 2003). Because social status (e.g., socioeconomic status, ethnicity/race, etc.) as a fundamental cause of health (Phelan et al.,

2004) determines the structural context of individuals' lives (Turner & Avison, 2003), socioeconomic disadvantages such as low income, low education, unmarried status, and ethnic/racial minority status put adults at risk for physical and mental health. In other words, individuals have unequal resources depending on socioeconomic, ethnic, and demographic characteristics, so these unequal resources are likely to lead to health disparities (Mendes de Leon et al., 2005). For instance, Cagney, Browning and Wen (2005) have reported that disadvantaged individuals are more likely to have no health insurance coverage, which in turn leads to more health problems. Because disadvantaged individuals without health insurance are not able to afford required medical expenses, they are likely to skip preventive health check-ups and to miss medical care for health problems; as a result, they develop more diseases or poorer health compared to their advantaged counterparts (Cagney, Browning, & Wen, 2005).

A substantial body of evidence indicates health declines with increasing age (Kelley-Moore & Ferraro, 2005; Long & Pavalko 2004; Ormel et al., 2002). Especially, older adults tend to have higher levels of functional impairments, more chronic diseases such as cancer, heart problems, and stroke, and depressive symptoms (Long & Pavalko, 2004; Ormel et al., 2002). Furthermore, older adults may experience the co-occurrence and comorbidity of these health problems, largely because the onset of one specific health problem is likely to increase the risk of other health problems over time (Kelley-Moore & Ferraro, 2005). However, only a few studies have identified the associations of multiple health problems in late adulthood. By studying the association of multiple health problems, this study tends to capture a more holistic view of health, reflecting a broader aspect of physical and mental health; thus, the present study will investigate an array of health problems and a variety of measures on health

disparities. Recent studies on health inequalities have emphasized the importance of studying dynamic changes in health disparities over time (Kelley-Moore, 2006). A relatively small number of studies have begun to investigate progression of multiple health outcomes over time. Therefore, this study will identify the trajectories of multiple health problems and the associations between these trajectories.

### *Methodological Concerns*

Most previous studies that have analyzed the influences of socioeconomic, ethnic/racial, and demographic factors on changes in health outcomes have employed auto-regressive approaches, predicting health status after controlling for lagged health status (Kelley-Moore & Ferraro, 2005; Ormel et al., 2002). These previous studies have provided valuable findings. However, if the stability of health problems over time is high, these models may not allow additional predictors to explain any variance in health (Wickrama, Beiser, & Kaspar, 2002). Unlike in auto-regressive models, latent growth curve models explicitly estimate individual changes in health, preserving the continuous nature of health outcomes over time and allowing predictors to explain variations in those changes (without controlling for the lagged effect) (Lorenz, Wickrama, & Conger, 2004). Also, latent growth curve approaches allow us to investigate (a) the influence of initial level of a health problem on changes in another health problem and (b) contemporaneous associations between levels and changes in different health problems (inter-locking trajectories) (Wickrama, Beiser, & Kaspar, 2002). In addition, latent growth curve modeling in a structural equation framework allows me to correct for attenuation of regression coefficients by taking measurement errors into account.

As previously mentioned, recent studies on health inequalities have emphasized the dynamic changes in health disparities over time (Kelley-Moore, 2006). A relatively small number of studies have begun to explore changes in health over time (Martin, Schoeni, Freedman, & Andreski, 2007). Therefore, this study explores longitudinal trajectories of multiple health problems among adults over 65 years old, utilizing latent growth curve modeling. Latent growth curve modeling (LGCM) estimates individual trajectories of health problems. Growth parameters in LGCM identify both the initial levels and slopes of health. LGCM focuses on individual trajectories and variability in growth parameters (the level and slope) around means for one sample. Specifically, the present study identifies the trajectories of health (e.g., physical limitations, chronic diseases, and depressive symptoms) in conjunction with the influences of socioeconomic, ethnic/racial, and demographic variables using the longitudinal data of the Health and Retirement Study. Thus, by utilizing latent growth curve analyses, this study can elucidate the way these health problems interrelate over time with intra-domain health processes, taking measurement errors into account. The present study may also contribute to a deeper understanding of the roles of socioeconomic, ethnic/racial, and demographic factors in health differences over time.

### ***Research Objectives***

There are two broad objectives in this study. First, this study examines the role of demographic and socioeconomic advantages/disadvantages on health problem trajectories among adults over 65 years old. In order to examine whether socioeconomic status confounded with demographic variables, the present study examines whether ethnic/racial and demographic variables (i.e., age, gender, marital status, and ethnicity/race) significantly

predict the initial levels and rates of change in physical limitations, chronic diseases, and depressive symptoms among adults over 65 years old. And then, this study investigated when socioeconomic status variables (i.e., education and income) were added, whether the influences of ethnic/racial and demographic variables on the initial levels and rates of change in physical limitations, chronic diseases, and depressive symptoms among adults over 65 years old remain significant. Next, this study investigates inter-related processes of different health domains. In specific, the present student examines whether the initial levels of one specific health problem predict rates of change (slopes) in another health problem. In addition, this study explores whether the levels and rates of change of different health problems covary (inter-locking trajectories).

The present study performs the analyses of latent growth curve modeling, using the data of the Health and Retirement Study (Health and Retirement Study, 2006), biennially collected from 1998 to 2006 by the Institute for Social Research at the University of Michigan and sponsored by the National Institute on Aging. Because this data set comes from a nationally representative survey and includes several ethnic subgroups with appropriate sample size, it meets the standard to investigate the objectives of this study.

It is expected that a more integrated understanding of health disparities in this study would contribute to advancement of public health programs in order to reduce or eliminate health disparities. It is also expected that this study with the analysis of latent growth curve modeling is likely to give insight into implications for public health policy in a long-term view (Bzostek, Goldman, & Pebley, 2007). With the findings of long-term detrimental effects of one health problem on other health problems, for instance, it is likely to be beneficial to provide comprehensive public programs for enhancing multiple health problems

for disadvantaged individuals in conjunction with increased chances to improve socioeconomic position, especially educational attainments. A comprehensive investigation of the processes involved in health disparities associated with socioeconomic, ethnic, and demographic variables together with multiple pathways and latent trajectories is likely to be useful to understand health disparities, to improve prevention or intervention programs, and to keep the attention of policy makers and the public on these issues.

### ***Dissertation Organization***

Chapter 2 provides theoretical frameworks and empirical backgrounds about health disparities including specific research objectives; as a result, Chapter 2 presents three theoretical perspectives, the life course perspective, the cumulative advantage/disadvantage perspective, and stress-process perspective and the literature review with specific hypotheses tested in the present study. Chapter 3 describes the sample, method, procedure, measurement, and data analysis procedure. Chapter 4 presents results of descriptive statistics, latent growth curve analyses of number of physical limitations, chronic diseases, and depressive symptoms, and the conceptual models of the present study. Finally, Chapter 5 provides a discussion of the findings and conclusions.

## CHAPTER 2. LITERATURE REVIEW

Health disparity is one of the most important issues in the studies of health. Health disparities refer to differences and inequalities in health status or health-related environments depending on an individual's socioeconomic status and ethnic/racial and demographic characteristics (Aneshensel, 1992; Cater-Pokras & Baquet, 2002; Kawachi et al., 2002). Disadvantaged individuals are likely to report substantially poorer health compared to any other groups, especially advantaged ones. Because disadvantaged individuals are more likely to be vulnerable to more adversities, disadvantaged individuals with adversities experience more severe deleterious consequences (Birch, Jerrett, & Eyles, 2000).

### *Theoretical Perspectives*

Three theoretical frameworks such as the life-course perspective, the cumulative advantage/disadvantage perspective, and the stress-process perspective may provide useful guidelines of how socioeconomic, ethnic/racial, and demographic characteristics affect health disparities over time (Alwin & Wray, 2005; Dannefer, 1987, 2003; DiPrete & Eirich, 2006; Elder, 1996; Lynch, 2008; Pearlin et al., 2005).

*The life-course perspective.* The life-course perspective plays an important role in understanding inequalities in health status by explaining the dynamic processes of how socioeconomic status, ethnicity/race, and demographic variables are associated with health disparities (Alwin & Wray, 2005; Lynch, 2008). The life-course perspective emphasizes that development is a lifelong process and a dynamic interplay of the continuing processes of an individual and his or her social context over time (Bengtson & Allen, 1993; Crosnoe &

Elder, 2002; Elder, 1996). Because development is a dynamic process in which individual development interacts with the social environment, especially in multilayered contexts with inter-connected social settings throughout the life course, individuals embedded in multiple contexts are likely to struggle with unequal social opportunities or constraints, which in turn lead to health disparities (Alwin & Wray, 2005; Elder, 1996; Lynch, 2008). The life-course perspective emphasized that the consequences of early transitions or events shape later experiences or events and the consequences of inequalities are fluid across the life course (Elder, 1996; Lynch, 2008). For example, the consequences of socioeconomic adversity during childhood are likely to be different from those of socioeconomic adversity throughout adulthood. Further, early socioeconomic adversity may combine with later adversity contributing to more severe and detrimental consequences in adulthood.

Especially, the life course perspective suggests that early experiences or events may operate as a “chain of risks/resources” over the life course, leading to accumulated consequences over time (Crosnoe & Elder, 2002). For instance, unexpected retirement may bring up the subsequent consequences of the loss of economic resources, of increased stress and strains, of reduced self-efficacy, and of high levels of psychological distress; as a result, these chained risks lead to the likelihood of unsuccessful aging processes. Accordingly, it is possible to argue that early socioeconomic disadvantages influence early health problems and initially activated health problems magnify over time which in turn acts as a health risk for more health problems over time.

Several studies have sought to demonstrate empirical results of socioeconomic and/or ethnic/racial differences in health status based on the life-course perspective (House, Lantz, & Herd, 2005; Kasper et al., 2008; Williams & Umberson, 2004). For example, House and

colleagues (2005) have examined continuity in and change of socioeconomic position in health disparities from 1986 to 2001/2002. Especially, they have identified cohort effects of education on functional limitations between 1986 and 2001/2002. Highly educated older adults in 2001/2002 reported lower levels of functional limitations compared with high-educated older adults in 1986. Kasper and colleagues (2008) have demonstrated the importance of timing and duration of poverty in functional status. Their study found that long-term poverty and family stress determined lower functional status among older adults, although early poverty and short-term family problems did not have lasting effects on functional status. Williams and Umberson (2004) have investigated whether marital status was associated with physical health through the life course. They demonstrated that unmarried adults reported higher levels of poor health than married ones and the deleterious effects of marital dissolution were greater for older adults compared to younger adults. These results suggest that the influences of marital status on physical health are differential across the life course.

*The cumulative advantage/disadvantage perspective.* Another perspective which attempts to account for health disparities over time is the cumulative advantage/disadvantage perspective (Dannefer, 1987, 2003). Demographic characteristics, especially ethnicity/race, as well as socioeconomic position shape individuals' exposure to and experience of protective or risk factors for health (Hatch, 2005; House, Lantz, & Herd, 2005); in turn, these different adverse or beneficial exposures and experiences lead to health inequalities over time. According to the cumulative advantage/disadvantage perspective, the effects of advantage/disadvantages persist from birth to later life and the impacts of advantage or

disadvantages are continuously combined throughout the life span; thus, small advantages or disadvantages at an early stage of a process grow larger over time (DiPrete & Eirich, 2006; Farkas, 2003; Hatch, 2005).

According to the cumulative advantage/disadvantage perspective, disadvantaged individuals go through accumulated adverse experiences such as economic strains, poor nutrition, limited access to health care, and poor neighborhood quality with high rates of crime, which in turn lead to more health problems and poor health status compared to their advantaged counterparts; on the other hand, privileged individuals with cumulative beneficial experiences such as socioeconomic abundance, increased sense of control, social support, and modeled positive health behaviors are likely to have better health compared to their disadvantaged counterparts (Hatch, 2005). Although cumulative disadvantage for some individuals corresponds to cumulative advantage for others, ethnic/racial inequalities in health are often framed in terms of cumulative disadvantage because the focus is on those who experience disadvantaged outcomes (DiPrete & Eirich, 2006). Recently, the cumulative advantage and disadvantage perspective began to emphasize that advantages or disadvantages may accumulate over time in a way that is multiplicative rather than additive (Evans, 2003).

Recently, researchers have paid more attention to identify mechanisms of health disparities throughout the life course within the cumulative advantage/disadvantage perspective (Wilson, Shuey, & Elder, 2007). Two processes for the emergence of health disparities have been proposed: a) a path-dependent process and b) an exposure-dependent process (DiPrete & Eirich, 2006). According to the path-dependent process, health disparities come about because earlier disadvantage may generate later disadvantage and these

combined disadvantages lead to more detrimental consequences in health status over time (DiPrete & Eirich, 2006; Wilson, Shuey, & Elder, 2007). On the other hand, the exposure-dependent process has focused on the durations of exposure to initial disadvantages. In other words, persistent and long-term exposure to a specific disadvantage may have more severe and deleterious influences on health trajectories over time (DiPrete & Eirich, 2006; Wilson, Shuey, & Elder, 2007).

Several studies have sought to demonstrate empirical results of ethnic/racial or socioeconomic differences in health status based on the cumulative advantage/disadvantage perspective (Clark, 1997; Shuey & Willson, 2008; Walsemann, Geronimus, & Gee, 2008). For example, Clark (1997) has also demonstrated the continuously widening ethnic differences between Blacks and Whites in functional impairment over time. In other words, functional impairment levels of Black older adults continued to become worse than those of White counterparts. Shuey and Willson (2008) have also found that an initial disparity in health between Blacks and Whites grows significantly with age. Blacks reported poorer health than Whites, and this gap grows each year to its widest point in late middle age, diminishing slightly thereafter but remaining considerably larger than in early adulthood. Walsemann and colleagues (2008) also found that greater educational advantage in youth is associated with lower probabilities of health-induced work limitations in adulthood and later onset of health-induced work limitations, and that the health gap between those with greater versus fewer educational advantages in youth widened with age.

*The stress-process perspective.* The last perspective which attempts to account for health disparities over time is the stress-process perspective. The process of stress consists of

three major conceptual domains: the sources of stress, the mediators of stress, and the manifestations of stress (Pearlin, Menaghan, Lieberman, & Mullan, 1981). In specific, considerable interests have been paid attention on the effects of life events and chronic life strains in research of the sources of stress; coping and social supports have had a rather dramatic rise to prominence in studying the mediating impacts of stress; and a variety of studies have been investigated from the biological response toward stress to behavioral and psychological expressions in a study of stress and its symptomatic manifestations (Pearlin et al., 1981). Depending on status variations such as socioeconomic, ethnic/racial and demographic characteristics, therefore, the present study paid attention to identify a variation in the trajectories of multiple health problems as the manifestation of stress.

Further, the stress-process theory (Pearlin et al., 2005) suggests that stress proliferates across different health domains over the life course. Consistent with the 'stress-proliferation' notion, stress-manifestation (health problems) also proliferates over the life course as intra-domain continuities and cross-domain proliferations as well. This study contends that health problems proliferate across different health domains such as physical limitations, chronic diseases, and depressive symptoms, as an inter-related process (Pearlin et al., 2005; Taylor & Lynch, 2004). Because physical impairments have been conceptualized as a chronic stressor affecting individuals persistently over time (Taylor & Lynch, 2004), for instance, physical impairment may cause a period of onset of adjustment or disruption, promoting feelings of worthlessness or hopelessness that may fuel depressive symptoms (Boerner, 2004; Bruce, 2001). As a result, stress-manifestation proliferation indicates that stress-manifestation elicits more deleterious consequences of health status (both an intra-domain and cross-domain proliferations).

To summarize, I propose an alliance of the life course perspective (Elder, 1994), the cumulative advantage/disadvantage perspective (Dannefer, 2003; Merton, 1988), and the stress-process perspective (Pearlin et al., 2005), that provides the theoretical guidance to understand the dynamic associations between socioeconomic characteristics and health problem trajectories in late adulthood. Consistent with the life course perspective, early socioeconomic characteristics exert a persistent influence on health outcomes over the life course (Elder, 1994; O’Rand, 1996). Also, consistent with the cumulative advantage/disadvantage perspective, the long-term effects of SES increase over the life course because of accumulation of human and material resources (conversely, disadvantages) over the life course that parallels increasing health heterogeneity (Lynch, 2003; Prus, 2007). That is, early socioeconomic advantage/disadvantage exerts a cumulative influence on health producing heterogeneity of health trajectories through ‘exposure-dependent’ and ‘path-dependent’ mechanisms. However, findings of previous research are mixed. Some studies suggest that these differences may not been seen past middle adulthood years for all health problems (House, Lantz, & Herd, 2005; House et al., 1994). Further, the stress-process theory (Pearlin et al., 2005) suggests that stress proliferates across different life domains over the life course. Consistent with the “stress-proliferation” notion, we argue that stress-responses (health problems) also proliferate over the life course across different health domains (cross-domain) and within the same domain (intra-domain) as well.

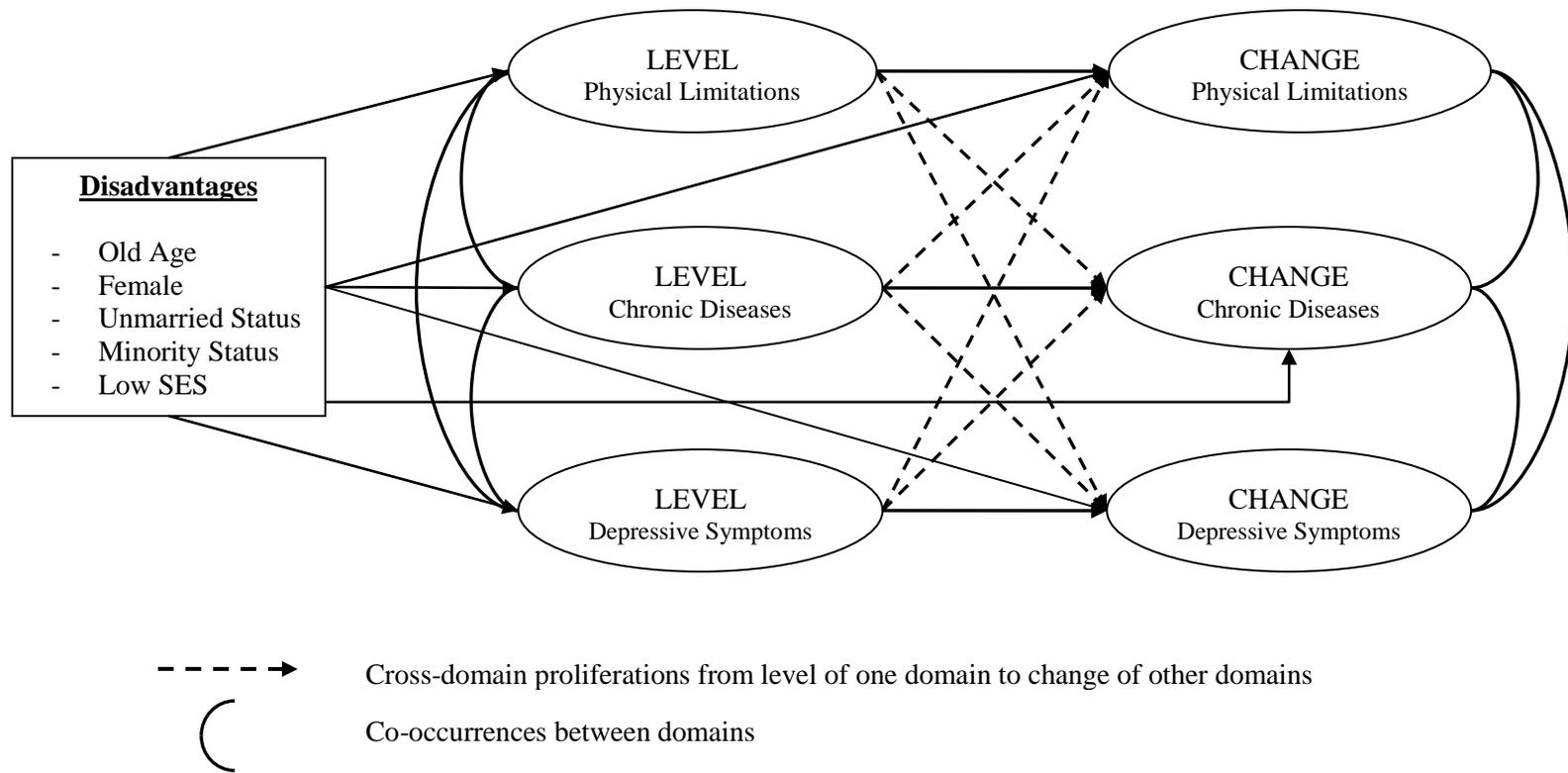
The alliance of the life course, the cumulative advantage/disadvantage and the stress process perspectives suggest that early socioeconomic characteristics exert persistent influence on health outcomes over the life course through a broadening cumulative process. However, very little is known about cross-domain proliferation and intra-domain continuities

of health problems in old adult years and how this inter-related dynamic process is influenced by SES and demographic characteristics. As a result, the life-course, the cumulative disadvantage/advantage, and stress-process perspectives provide the comprehensive understanding of 1) diverse consequences of disadvantage, 2) the continuity of health problems, and 3) inter-related health outcomes over the life course (Pearlin et al., 2005).

Thus, the objective of this study is to explore the persistent long-term influences of demographic and socioeconomic advantages/disadvantages on the inter-related progression of multiple health problems in late adulthood, as presented in Figure 1 representing our theoretical model. Using the data of the Health and Retirement Study ( $N = 4,374$ ) collected biennially from 1998 to 2006, in the present study, I will explore four specific research questions:

- 1) Whether demographic (i.e., age, gender, marital status, and ethnicity/race) advantages/disadvantages significantly predict the initial levels and rate of changes in physical limitations, chronic diseases, and depressive symptoms among adults over 65 years old with and without socioeconomic status,
- 2) Whether socioeconomic (i.e., education and income) advantages/disadvantages significantly predict the initial levels and rate of changes in physical limitations, chronic diseases, and depressive symptoms among adults over 65 years old,
- 3) Whether the initial levels of one specific health problem predict rates of change (slopes) in another health problem, and
- 4) Whether the levels and rates of change of different health problems covary (inter-locking trajectories).

In the next section, I will discuss the expected associations shown in Figure 1.



*Figure 1.* Demographic and Socioeconomic Disadvantages and Trajectories of Health Problems in Different Health Domains in Late Adulthood.

### ***Literature Review***

Age, gender, marital status, ethnic/racial minority status and socioeconomic status, will have unique influences on the initial levels and rates of change in health problems during late adulthood.

*Age and health.* A number of studies about health disparities explore age effects or age changes in health inequalities. First, numerous studies have explored age effects on health status. Previous studies demonstrated that older adults experience more physical limitations, chronic diseases, and depressive symptoms than middle-aged adults (Schieman, van Gundy, & Taylor, 2001). Physically impaired older adults do not live alone, which in turn decreases a sense of independence among physically impaired older adults (Taylor & Lynch, 2004). Chronic diseases provide a threatening condition for older adults due to limited physical functioning and medical expenses. Depressive symptoms are a costly and potentially disabling condition affecting substantial proportions of older adults (Glass et al., 2006).

Next, a substantial body of evidence indicates changes in health status with increasing age (Kelley-Moore & Ferraro, 2005; Long & Pavalko 2004; Ormel et al., 2002). Especially, older adults have a higher likelihood of involvement in functional impairment, and tend to have more chronic diseases such as cancer, heart problems, stroke, and depressive symptoms (Long & Pavalko, 2004; Ormel et al., 2002). By studying age effects and age changes of health status with longitudinal data, this study may contribute to the better understanding of processes of health disparities over time. Further, because late adulthood is a period during which older adults are more likely to show increasing levels of health problems, the present

study will investigate the influences of age groups (i.e., age effects) on the levels and rates of change (i.e., age changes) in health problems during old adulthood.

*Gender and health.* A substantial number of studies have paid attention to gender differences in health status (Arber & Cooper, 1999; Verbrugge, 1976). Although women have lower rates of mortality, they report higher levels of depression, psychiatric disorders, distress, and a variety of chronic illnesses than men (Denton, Prus, & Walters, 2004). However, the direction and magnitude of gender differences in health vary depending on domains of health problems and phase of the life span (Denton et al., 2004). It is clear that women report higher levels of psychological distress across the life course but it is not apparent that women have more physical symptoms (Denton et al., 2004). Thus, the present study will investigate gender influences on the levels and rates of change in health problems in late adulthood.

*Marital status and health.* Numerous studies have explored the influences of marital status on physical and mental health of adults (Bennett, 2006; Williams & Umberson, 2004). Past studies have found that marriage has a beneficial effect on health status throughout the life span. Furthermore, the deleterious effects of marital dissolution are greater for older adults compared to younger adults (Williams & Umberson, 2004). Unmarried adults, especially if never-married, showed higher rates of mortality, divorced adults experienced greater psychological and health problems over time and widowed adults reported significantly lower levels of self-rated health over time, compared to their married

counterparts (Bennett, 2006; Lorenz et al., 2006; Wickrama et al., 2006). Thus, the present study will investigate the influences of marital status on both the levels and rates of change in health problems in late adulthood.

*Ethnic/racial status and health.* A substantial number of studies have identified ethnic health disparities, especially between White and Black Americans. Blacks have higher mortality rates (Levine et al., 2001), a higher rate of functional limitations (Liao et al., 1999), and more mental problems (Skarupski et al., 2005) compared to their White counterparts. Several studies have also demonstrated that Hispanics were more likely to report poor self-rated health compared to their White counterparts (Bzostek, Goldman, & Pebley, 2007). A recent study by Walseman and colleagues (2009) shows that ethnic differences of depressive symptom trajectories are eliminated partly in early adulthood when demographic and socioeconomic factors are taken into account. It appears that ethnic differences in health trajectories vary depending on the age-segment and the type of health problem being investigated. The present study will further investigate the influence of ethnicity/race on the levels and rates of change in health problems in late adulthood.

Past studies concerning ethnic/racial health disparities have paid attention to ethnic/racial differences in health status between Blacks and Whites (Clark, 1997; Kelley-Moore & Ferraro, 2004; Levine, et al., 2001); these studies consistently reported that Black Americans have more health problems and poorer health than their White counterparts. Whereas the rapid increases in the Hispanic populations in the United States highlight the importance of studying characteristics of health in Hispanic Americans (National Alliance

for Hispanic Health, 2005), empirical studies about Hispanic health status are relatively scarce. Although recent studies (Bzostek, Goldman, & Pebley, 2007; Goldman, Kimbro, Turra, & Pebley, 2006; Turra & Goldman, 2007) have begun to identify the health characteristics in Hispanic Americans, they have been limited to comparisons between Hispanics and non-Hispanic Whites in health status. Therefore, this study extends to investigate characteristics of ethnic/racial health disparities including Hispanics as well as Blacks and Whites.

*Socioeconomic characteristics and health.* Socioeconomic characteristics are fundamental causes of health (Lantz et al., 2001; Phelan et al., 2004; Warren & Herbabdez, 2007; Wray, Alwin, & McCammon, 2005); that is, individuals with low levels of education, less income, and unskilled and dangerous occupations are likely to show higher rates of morbidity and mortality than their advantaged counterparts (Schnittker, 2004). In particular, socioeconomic disparities in adult health change over time. Individuals in low socioeconomic positions have significantly lower levels and faster decline in physical and mental health (Lantz et al., 2001; Phelan et al., 2004) when compared to individuals in high socioeconomic positions.

Socioeconomic status plays an important role in accounting for effects of demographic variables on health disparities, especially ethnic/racial health disparities. In other words, demographic variables as well as ethnicity/race are closely linked with socioeconomic status. Specifically, ethnic/racial minorities are more likely to be in low socioeconomic positions such as low median earnings in 1999 (U.S. Census Bureau, 2000).

According to U.S. Census data in 2000, for instance, the percentage of minorities with an income in 1999 below the poverty level was twice that of their White counterparts; that is, race/ethnic minorities experience constraints and limitations in educational opportunities, in accessibility to high-valued occupations, and in high income (Kelley-Moore & Ferraro, 2004; Ren & Amick, 1996). Because previous studies have indicated that socioeconomic status explains a great portion of demographic and ethnic/racial differences in health status (Ren & Amick, 1996), the present study will explore whether socioeconomic disparities confound with demographic and ethnic/racial differences in health status in old-age.

According to the cumulative advantage/disadvantage perspective, the impacts of advantage/disadvantage increase throughout the life course, reflecting widening differences in human and material resources (Mirowsky & Ross, 2005; Prus, 2007). Accordingly, several studies have demonstrated that the socioeconomic differences of adult health persist and even increase in old age (Mirowsky & Ross, 2005; Prus, 2007). On the other hand, other studies (House, Lantz, & Herd, 2005; House et al., 1994) indicated that although SES differences on health increase during the period between early adulthood and early old age, SES differences begin to diminish in late adulthood. This “compression” in health status may be attributed to selective mortality and morbidity. Socioeconomically disadvantaged individuals show persistently higher levels of morbidity and disability throughout adulthood, whereas their advantaged counterparts show increasing morbidity and functional limitations when reaching older ages; as a result, the SES gap of health declines during old years (House et al., 2005). Thus, previous research has shown mixed findings with respect to change in socioeconomic differences in late adulthood. The present study will explore these potential SES differences

by investigating SES influences on the levels and rates of change in health problems during late adulthood years. Because a majority of older adults did not work due to retirement and other reasons, years of education and household income are used markers of socioeconomic status as a latent construct.

*Inter-related processes of different health domains.* The present study investigates cross-domain influences of multiple health domains, functional impairment, chronic illness, and mental health. This study also takes into account contemporaneous associations or dependencies among these health problems. First, physical limitations may contribute to poor physical health due to a sedentary lifestyle and lack of exercise and changes in physical limitations may also result in elevated levels of depressive symptoms (Schnittker, 2005). Second, chronic diseases influence functional impairments (Schnittker, 2005; Verbrugge & Jette, 1994); that is, having chronic diseases may have consequences for the loss of physical functioning (Verbrugge & Jette, 1994). Furthermore, some chronic diseases such as hypertension, cardiovascular disease, and diabetes may contribute to the onset and persistence of depressive symptoms (Alexopoulos et al., 1996; Schnittker, 2005). Finally, depressive symptoms have been shown to predict the onset of functional limitations and chronic diseases (van Gool et al., 2005). Depressed persons reported higher levels of poor physical health later, by decreasing physical activity and social interaction. However, it is difficult to conclude the directions in the associations of different health problems because little research has explored multiple health outcomes in a study.

Also, past studies have documented reciprocal relationships between two health outcomes (Aneshensel et al., 1984; Gayman, Turner, & Cui, 2008). For example, depression and disability mutually contribute to the other's risk over time (Bruce, 2000; Ormel et al., 2002). More recent studies have begun to identify the mediating role of a third health outcome. For example, Geerlings and colleagues (2001) have demonstrated that the effect of chronic physical diseases was most apparent with respect to the relation between depression and disability. However, these studies do not clarify the directions in the associations of different health problems. Thus, the present study will examine these cross-domain influences of physical limitations, chronic diseases and depressive symptoms in later adulthood years.

## CHAPTER 3. METHODOLOGY

### *Participants and Procedure*

This study used the data from the Health and Retirement Study (HRS), collected in 1998, 2000, 2002, 2004, and 2006. The purpose of the HRS is to investigate physical and mental health, insurance coverage, financial status, family support systems, labor market status, and retirement planning among adults over 50 years old (Health and Retirement Study, 2006). Data of the HRS in 1998 were merged from two studies, the original HRS cohort born 1931-41 first interviewed in 1992 (at 51-61 years of age) and the Aging and Health Dynamics (AHEAD) cohort born before 1923 first interviewed in 1993 (ages 70 and above). The HRS in 1998 became a complete longitudinal panel of the population over age 50, with over 20,000 participants combined with new respondents born 1942 and 1947. The participants in the HRS were nationally representative, with African-Americans and Hispanic Americans oversampled.

The target population for the original HRS and the AHEAD included all adults in the United States born during the target cohorts who reside in households. Institutionalized persons (i.e. those in prisons, jails, nursing homes, or long-term care facilities) were initially excluded from the survey population. Because the original HRS and the AHEAD is a sample of households with at least one person born during the target cohorts, the age-eligible target person and his/her spouse or partner were interviewed, if they consented to participate in the study voluntarily. Persons who interviewed in the baseline data collection (the original HRS sample in 1992 and the AHEAD sample in 1993) were reinterviewed and target respondents' spouses and partners at any previous wave were reinterviewed. If respondents reported new

spouses and partners at the time of a reinterview, the new spouses and partners were also interviewed. If respondents have died, *exit* interviews would be sought with a proxy informant who is knowledgeable about the family and financial situation of the deceased.

The overall response rate at any follow-up wave was higher than 80%. Especially among about 20,000 participants who were over 50 years old in 1998, just over 14,000 individuals participated in the re-interview conducted in 2006. Attrition may be due to mortality and refusal to interview. Because this study focused on health decline of older adults over 65 years, we selected participants over 65 years. We also removed Native Indians, Asians, and other races from the sample because of the small number of participants. This resulted in 4,374 older adults from the HRS. Thus, the HRS provided the necessary longitudinal data for this study to compute trajectories in health status of Americans over 65 years of age. Further details regarding the sample are available at <http://hrsonline.isr.umich.edu/data/index.html>.

A total of 62.8% older adults in this sample were female ( $n = 2,749$ ) and 37.2% were male ( $n = 1,625$ ). The mean age was 72.73 years, ranging from 65 to 97 years old. More than 80% of older adults in this sample were non-Hispanic Whites ( $n = 3,590$ ), 11.5% were African Americans ( $n = 503$ ), and 6.4% were Hispanic Americans ( $n = 281$ ). A total of 67.7% older adults were married ( $n = 2,149$ ). A total of 34% older adults ( $n = 1,487$ ) had more than a high school diploma. The mean yearly household income was 39,267.66 dollars.

## ***Measures***

### *Outcome Variables*

*Physical limitations.* The measure of the Activities of Daily Living (ADLs) was used to assess physical limitations. Individuals were asked whether because of a health or memory problem they had any difficulty with (1) dressing, including putting on shoes and socks, (2) walking across a room, (3) bathing or showering, (4) eating such as cutting up food, (5) getting in or out of bed, and (6) using the toilet, including getting up and down. Scores ranged from 0 (no difficulty) to 6 (most difficult). High scores on activities of daily living show a high number of physical limitations in this study. Cronbach's alphas for this measure in this sample in 1998, 2000, 2002, 2004, and 2006 were .70, .68, .77, .79, and .79, respectively.

*Chronic diseases.* Individuals were asked whether a doctor had ever told them that they had the following health problems, (1) high blood pressure or hypertension, (2) diabetes or high blood sugar (3) cancer or a malignant tumor, excluding minor skin cancers, (4) chronic lung disease such as chronic bronchitis or emphysema, (5) a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems, (6) a stroke, and (7) arthritis or rheumatism. The chronic disease index was computed by counting a number of chronic diseases. Scores ranged from 0 (none) to 7 (all seven diseases) but it was recalculated to from 0 (none) to 5 (5 or more chronic diseases). High scores for this scale indicated a high number of chronic diseases.

*Depressive symptoms.* The short-version of the Center for Epidemiology Depression Scale (CES-D, Radloff, 1977) was used to assess depressive symptoms. Individuals were asked whether (1) they felt that everything they did was an effort, (2) their sleep was restless, (3) they were happy, (4) they felt lonely, (5) they enjoyed life, (6) they felt sad, (7) they

could not get going, and (8) they had a lot of energy during the past week. The depressive symptom scale was computed by summing scores on those 8 items. Scores ranged from 0 (no symptoms) to 8 (8 symptoms). High scores of this scale show a high number of depressive symptoms. Cronbach's alphas for this measure in this sample in 1998, 2000, 2002, 2004, and 2006 were .74, .74, .76, .76, and .76, respectively.

### *Demographic and Socioeconomic Variables*

*Age.* Age was categorized into three groups, adults 65-74 years of age, 75-84 years of age, and over 85 years old.

*Gender.* Gender was divided into two groups, women and men.

*Marital status.* Respondents reported their marital status in married, separated, divorced, widowed, and never married. A dichotomous variable indicated whether the respondent was married or not.

*Ethnicity/race.* Respondents answered two questions regarding ethnic/racial status: a) "Do you consider yourself Hispanic or Latino?" and b) "Do you consider yourself primarily white or Caucasian, Black or African American, American Indian, or Asian, or something else?" Respondents were categorized into non-Hispanic Whites, African-Americans, Hispanic-Americans, American Indian, and Asian. This study included three ethnic groups, non-Hispanic Whites, African-Americans, and Hispanic-Americans.

*Socioeconomic status (SES).* Respondents reported their years of education and income. Socioeconomic status was captured using a latent construct with two indicators: years of education and household income. Years of education ranged from 0 to 17. Yearly

household income was categorized into six groups, less than \$10,000, less than \$20,000, less than \$35,000, less than \$50,000, less than \$75,000, and more than \$75,000 dollars. Education was correlated with household income ( $r = .48, p < .001$ ). High scores on this scale indicated high socioeconomic status.

### *Analyses*

First, we examined the linear changes in multiple health outcomes (i.e., physical limitations, chronic diseases, and depressive symptoms) over time by estimating univariate latent growth curves (LGCs). There are two latent variables with initial levels and slopes. The initial levels and slopes refer to the means of health outcomes at the first wave of measurement and the means of linear change rates in terms of health problems, respectively. Repeated measurements of the variables at five time points served as multiple indicators of the initial levels and slopes of multiple health problems. Factor loadings for all the measured indicators of each initial level were fixed to 1. Factor loadings for each latent linear slope were defined 0, 1, 2, 3, and 4 for five successive equally-spaced assessments.

The first level model predicts the health outcomes (e.g., physical limitations, chronic diseases, and depressive symptoms) for individuals at any time point.

1st Level Model (individuals):

$$\text{Health Outcome } (Y_1) = \beta_0 + \beta_1(\text{TIME}) + \text{Error} \quad - (1a)$$

(e.g., physical limitations)

$$\text{Health Outcome } (Y_2) = k_0 + k_1(\text{TIME}) + \text{Error} \quad - (1b)$$

(e.g., chronic diseases)

The second level model predicts the within individual parameters  $\beta_0$  and  $\beta_1$ , and  $k_0$  and  $k_1$  using SES and demographic factors (DEM) as predictors.

2<sup>nd</sup> Level Model (between individuals):

$$\beta_0 = \gamma_{00} + \gamma_{01}(SES) + \gamma_{02}(DEM) + \gamma_{03}(k_0) + Error \quad - (2a)$$

$$\beta_1 = \gamma_{10} + \gamma_{11}(SES) + \gamma_{12}(DEM) + \gamma_{13}(k_0) + Error \quad - (2b)$$

$$k_0 = \rho_{00} + \rho_{01}(SES) + \rho_{02}(DEM) + \rho_{03}(\beta_0) + Error \quad - (2c)$$

$$k_1 = \rho_{10} + \rho_{11}(SES) + \rho_{12}(DEM) + \rho_{13}(\beta_0) + Error \quad - (2d)$$

Combined Equation:

$$Y_1 = \gamma_{00} + \gamma_{01}(SES) + \gamma_{02}(DEM) + \gamma_{03}(k_0) + \gamma_{10}(TIME) \\ + \gamma_{11}(TIME*SES) + \gamma_{12}(TIME*DEM) + \gamma_{13}(TIME*k_0) + Errors \quad - (3a)$$

$$Y_2 = \rho_{00} + \rho_{01}(SES) + \rho_{02}(DEM) + \rho_{03}(\beta_0) + \rho_{10}(TIME) \\ + \rho_{11}(TIME*SES) + \rho_{12}(TIME*DEM) + \rho_{13}(TIME*\beta_0) + Errors \quad - (3b)$$

The second level equations and the combined equation  $\gamma_{01}$ ,  $\gamma_{02}$ ,  $\gamma_{11}$ , and  $\gamma_{12}$  reflect the influences of SES and demographic characteristics (age, gender, marital status, and ethnicity/race), and time on the *level of health outcome trajectories*, respectively. These influences indicate the degree of SES and demographic inequality in health outcomes. In addition,  $\gamma_{11}$  reflects the diminishing/increasing effect of SES over time and these

multiplicative influences reflect the potential changes (equalization and differentiation) in SES-based inequality in health outcomes over time.  $\gamma_{12}$  also reflects the diminishing/increasing effect of demographic characteristics over time and these multiplicative influences reflect the potential changes (equalization and differentiation) in demographic-based inequality in health outcomes over time.

The present study estimated similar models for number of physical limitations, chronic diseases, and depressive symptoms as a comprehensive associated model after taking into account their dependencies and cross-domain influences as shown in Figure 1. In an associated model with two growth curves, two first-level equations converged to two growth curves (e. g., 1a & 1b). In second-level equations, growth parameters of one growth curve were predicted by growth curve parameters of the other. This study also estimated associated LGC of multiple health problems with predictors, identifying the longitudinal effects of demographic and socioeconomic characteristics (old age, female, unmarried, racial/ethnic minority status, and low socioeconomic status) on trajectories of multiple health problems.

Estimation of latent growth curve modeling was carried out using maximum likelihood of the EM algorithm in the Mplus software program (Muthén & Muthén 2004). In order to control for missing data, we used full-information maximum likelihood (FIML) (Abraham & Russell, 2004). FIML does not impute the missing values but it estimates model parameters and standard errors directly using all observed data (Abraham & Russell, 2004). FIML is a direct method in the sense that model parameters and standard errors are estimated directly from all available data (Abraham & Russell, 2004).

As goodness of fit indices, we used the chi-square test, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). If the indices of the CFI ranging from zero to 1.00 have values higher than .90, the values of the CFI indicate an acceptable fit to the data. In addition, lower than .05 in values of the RMSEA and SRMR ranging from zero to 1.00 indicates an acceptable fit (Byrne, 1998).

## CHAPTER 4. RESULTS

This chapter presents descriptive statistics with a correlation matrix among all the study variables as well as results of univariate latent growth curve analyses in health problems (physical limitations, chronic diseases, and depressive symptoms). In addition, latent growth curve analyses with predictors are presented to test models of the effects of demographic characteristics and ethnicity/race with and without socioeconomic status, in order to test whether the effects of demographic characteristics and ethnicity/race on health problems are confounded with those of socioeconomic status, the present study analyzes the models with and without socioeconomic status. Results of cross-domain influences and interlocking trajectories in health problems are also presented.

### *Descriptive Statistics*

The mean years of education in this sample were 11.83 years. A total of 12.3% older adults in this sample had earned less than 10,000 dollars ( $n = 538$ ), 22.9% did between 10,000 and 20,000 dollars ( $n = 998$ ), 27.9% did between 20,000 and 35,000 dollars ( $n = 1,216$ ), 14.6% did between 35,000 and 50,000 dollars ( $n = 638$ ), 11.7% did between 50,000 and 75,000 dollars ( $n = 512$ ), and 10.5% did over 75,000 dollars ( $n = 456$ ). A total of 64.5% older adults in this sample were young-old ( $n = 2,823$ , 65-74 years), 31.5% were old-old ( $n = 1,379$ , 75-84 years), and about 4% were oldest-old ( $n = 172$ , over 85 years). A total of 62.8% older adults in this sample were female ( $n = 2,749$ ) and 37.2% were male ( $n = 1,625$ ). A total of 67.7% older adults in this sample were married ( $n = 2,149$ ). More than 80% of older adults in this sample were non-Hispanic Whites ( $n = 3,590$ ), 11.5% were African Americans ( $n = 503$ ), and 6.4% were Hispanic Americans ( $n = 281$ ).

Means of number of physical limitations were .37, .40, .37, .45, and .58 from 1998 to 2006, showing an increasing pathway. Means of number of chronic diseases were 1.84, 1.97, 2.21, 2.39, and 2.55 from 1998 to 2006, showing an increasing pathway. Means of number of depressive symptoms were 1.52, 1.53, 1.58, 1.62, and 1.79 from 1998 to 2006, showing an increasing pathway. A summary of detailed descriptive statistics in this study is presented in Table 1.

Table 2 presents the numbers of and percentages of individuals who experienced each specific chronic disease from 1998 to 2006. The most prevalent chronic disease in this study was arthritis; that is, 65.3%, 71.0%, 74.9%, 77.5%, and 79.9% of individuals indicated that they experienced arthritis from 1998 to 2006, respectively. The next prevalent chronic disease in this study was high blood pressure; that is, 54.0%, 57.1%, 61.9%, 66.5%, and 69.6% of individuals indicated that they experienced high blood pressure from 1998 to 2006, respectively. The incidence of chronic diseases increased from 1998 to 2006.

Table 3 presents the correlation matrix for all the study variables. All health problem variables (i. e., number of physical limitations, chronic diseases and depressive symptoms) were correlated with one another. Almost all the correlations between the socioeconomic and demographic variables and the health problem variables were significant. The few exceptions were the correlations between age and physical limitations in 1998; the correlations between age and chronic diseases in 2004 and in 2006, respectively; the correlations between age and depressive symptoms in 2004; the correlations between gender and physical limitation in 2002 and in 2004, respectively; and the correlations between gender and chronic diseases in 1998, in 2000, in 2002, and in 2004, respectively.

Table 1. Descriptive Statistics of All Study Variables

Variable	Wave 1 (1998)		Wave 2 (2000)		Wave 3 (2002)		Wave 4 (2004)		Wave 5 (2006)	
	M	SD	M	SD	M	SD	M	SD	M	SD
Physical Limitations	.37	.92	.40	.93	.37	.88	.45	1.01	.58	1.17
Chronic Diseases	1.84	1.15	1.97	1.17	2.21	1.20	2.39	1.22	2.55	1.22
Depressive Symptoms	1.52	1.82	1.53	1.85	1.58	1.91	1.62	1.92	1.79	1.99
Socioeconomic & Demographic Variables										
Education (year)	11.83	3.32								
Household Income (dollars)	39,267.66	47,270.57								
Less than 10,000 (%)	12.3									
10,000 - 20,000 (%)	22.9									
20,000 - 35,000 (%)	27.9									
35,000 - 50,000 (%)	14.6									
50,000 - 75,000 (%)	11.7									
≥ 75,000 dollars (%)	10.5									
Young-old (%)	64.5									
Old-old (%)	31.5									
Oldest-old (%)	3.9									
Male (%)	37.2									
Female (%)	62.8									
Married (%)	68.1									
White (%)	82.1									
African American (%)	11.5									
Hispanic American (%)	6.4									

Table 2. The Numbers and Percentages of Individuals Experiencing Chronic Diseases

Chronic Diseases	Wave 1 (1998)		Wave 2 (2000)		Wave 3 (2002)		Wave 4 (2004)		Wave 5 (2006)	
	n	%	n	%	n	%	n	%	n	%
High Blood Pressure	2,362	54.0	2,415	57.1	2,618	61.9	2,810	66.5	2,998	69.6
Diabetes	647	14.8	682	16.0	797	18.7	898	21.0	1,011	23.3
Cancer	603	13.8	657	15.4	771	18.0	854	20.0	969	22.3
Chronic Lung Disease	407	9.3	387	9.1	452	10.6	510	12.0	577	13.3
Heart Problems	964	22.0	1,096	25.8	1,373	32.3	1,564	36.8	1,760	40.8
Stroke	228	5.2	256	6.0	321	7.3	392	9.2	477	11.1
Arthritis	2,855	65.3	2,998	71.0	3,147	74.9	3,263	77.5	3,438	79.9

Table 3. Correlations among All Study Variables

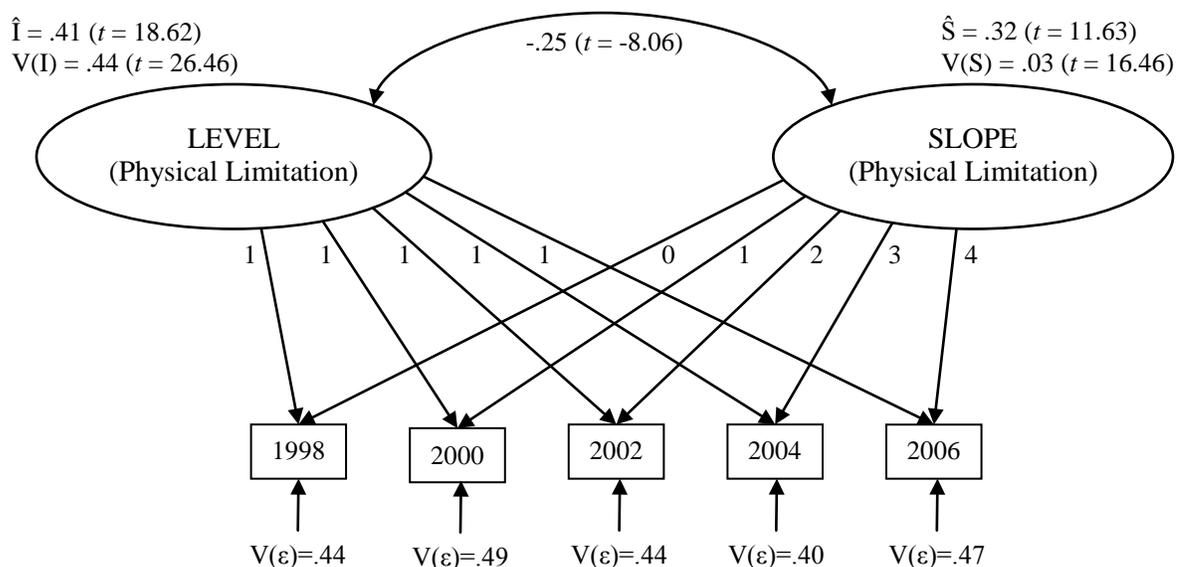
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
1. Limitations 98	1.00																						
2. Limitations 00	.58***	1.00																					
3. Limitations 02	.50***	.54***	1.00																				
4. Limitations 04	.45***	.50***	.60***	1.00																			
5. Limitations 06	.37***	.44***	.47***	.60***	1.00																		
6. Diseases 98	.20***	.18***	.19***	.18***	.19***	1.00																	
7. Diseases 00	.18***	.18***	.19***	.18***	.19***	.87***	1.00																
8. Diseases 02	.16***	.17***	.18***	.18***	.18***	.77***	.87***	1.00															
9. Diseases 04	.15***	.15***	.17***	.18***	.18***	.70***	.78***	.87***	1.00														
10. Diseases 06	.14***	.13***	.14***	.16***	.19***	.65***	.72***	.79***	.88***	1.00													
11. Depression 98	.27***	.25***	.22***	.19***	.18***	.18***	.17***	.15***	.14***	.11***	1.00												
12. Depression 00	.26***	.29***	.23***	.23***	.21***	.17***	.17***	.16***	.13***	.13***	.55***	1.00											
13. Depression 02	.23***	.23***	.27***	.23***	.23***	.15***	.15***	.16***	.14***	.13***	.51***	.54***	1.00										
14. Depression 04	.22***	.21***	.21***	.26***	.24***	.17***	.16***	.16***	.15***	.16***	.47***	.51***	.55***	1.00									
15. Depression 06	.17***	.18***	.18***	.22***	.30***	.16***	.17***	.16***	.15***	.16***	.44***	.47***	.52***	.58***	1.00								
16. Education	-.14***	-.13***	-.14***	-.13***	-.13***	-.10***	-.08***	-.07***	-.05***	-.03*	-.25***	-.22***	-.22***	-.20***	-.21***	1.00							
17. Income	-.17***	-.15***	-.18***	-.17***	-.16***	-.12***	-.09***	-.07***	-.08***	-.05**	-.23***	-.22***	-.20***	-.20***	-.20***	.48***	1.00						
18. Age	.02	.06***	.09***	.14***	.18***	.04**	.05***	.05***	.03	.01	.06***	.04*	.04*	.03	.05**	-.06***	-.15***	1.00					
19. Female	.05**	.06***	.03	.03	.04*	-.01	-.02	-.03	-.03	-.05***	.14***	.13***	.13***	.11***	.12***	-.03	-.23***	.07***	1.00				
20. Married	-.10***	-.11***	-.11***	-.15***	-.15***	-.06***	-.04*	-.05**	-.05**	-.04*	-.12***	-.09***	-.10***	-.08***	-.10***	.10***	.42***	-.29***	-.30***	1.00			
21. Black	.06***	.09***	.06***	.08***	.07***	.09***	.07***	.05***	.05**	.04**	.10***	.09***	.09***	.09***	.06***	-.20***	-.23***	.01	.06***	-.17***	1.00		
22. Hispanic	.07***	.09***	.07***	.06***	.05***	-.03*	-.03*	-.04**	-.04**	-.04**	.14***	.10***	.09***	.07***	.07***	-.37***	-.20***	-.03*	.01	-.01	-.09***	1.00	

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

### ***Univariate Linear Growth Curve Model***

To model the univariate linear growth curve model for multiple health outcomes of the five waves of measurement from 1998 to 2006 every two years, a linear growth model for continuous outcomes was estimated by maximum likelihood estimation using Mplus.

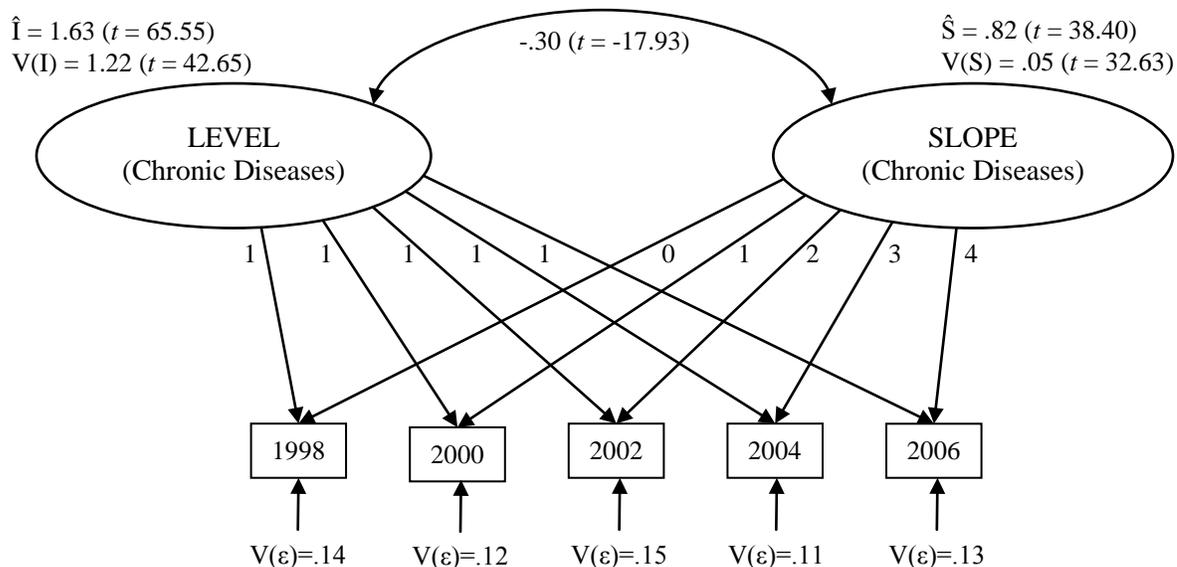
The results of the univariate linear growth curve analysis for number of physical limitations (Figure 2) show a significant mean estimate for the intercept term ( $.41, t = 18.62$ ) and a significant estimate for the positive slope term ( $.32, t = 11.63$ ). It means that older adults reported increased number of physical limitations over time. Significant variances in intercept ( $.44, t = 26.46$ ) and slope ( $.03, t = 16.46$ ) of number of physical limitations were also observed. It means that older adults reported different levels of physical limitations and increasing and decreasing rates of change in number of physical limitations. The level and slope of number of physical limitations were negatively correlated ( $r = -.25, t = -8.06$ ); that is, the higher initial level of physical limitations was associated with the lower rates of change in physical limitation. Given the significant variance in slope, the model is appropriate for further analysis using a latent growth curve analysis.



$$\chi^2 (10) = 202.51, CFI = .97, RMSEA = .07, SRMR = .04$$

Figure 2. Univariate Linear Growth Curve of Physical Limitations.

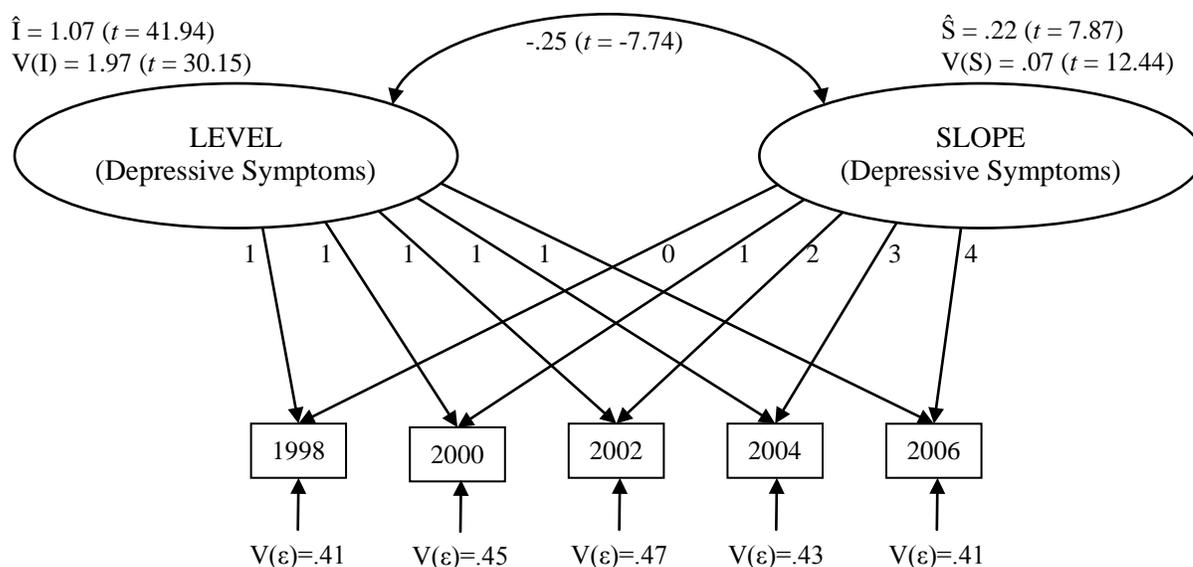
As presented in Figure 3, the results of the univariate linear growth curve analysis for number of chronic diseases show a significant mean estimate for the intercept term (1.63,  $t = 65.55$ ) and a significant estimate for the slope term (.82,  $t = 38.40$ ). It means that older adults reported increased numbers of chronic diseases over time. Significant variances in intercept (1.22,  $t = 42.65$ ) and slope (.05,  $t = 32.63$ ) of chronic diseases were also observed. It means that older adults reported different numbers of chronic diseases and increasing and decreasing rates of change in number of chronic diseases. The level and slope of number of chronic diseases were negatively correlated ( $r = -.30$ ,  $t = -17.93$ ); that is, the higher initial level of chronic diseases was associated with the lower rates of change in chronic diseases. Given the significant variance in slope, the model is appropriate for further analysis using a latent growth curve analysis.



$$\chi^2 (10) = 1005.55, CFI = .96, RMSEA = .15, SRMR = .05$$

Figure 3. Univariate Linear Growth Curve of Chronic Diseases.

As presented in Figure 4, the results of the univariate linear growth curve analysis for number of depressive symptoms show a significant mean estimate for the intercept term (1.07,  $t = 41.94$ ) and a significant estimate for the slope term (.22,  $t = 7.87$ ). It means that older adults reported increased levels of depressive symptoms over time. Significant variances in intercept (1.97,  $t = 30.15$ ) and slope (.07,  $t = 12.44$ ) of depressive symptoms were also observed. It means that older adults reported different numbers of depressive symptoms and increasing and decreasing rates of change in number of depressive symptoms. The level and slope of number of depressive symptoms were negatively correlated ( $r = -.25$ ,  $t = -7.74$ ); that is, the higher initial level of depressive symptoms was associated with the lower rates of change in depressive symptoms. Given the significant variance in slope, the model is appropriate for further analysis using a latent growth curve analysis.



$$\chi^2 (10) = 202.51, CFI = .97, RMSEA = .07, SRMR = .04$$

Figure 4. Univariate Linear Growth Curve of Depressive Symptoms.

***Testing Model of Demographic Characteristics and Ethnicity/Race without SES***

Table 3 shows the influences of demographic characteristics on number of physical limitations, chronic diseases, and depressive symptoms. Age had positive influences on initial levels of chronic diseases ( $\beta = .05, t = 2.80$ ) and depressive symptoms ( $\beta = .05, t = 2.31$ ), suggesting that older old-adults reported more chronic diseases and depressive symptoms at the baseline than younger old-adults. Age also had a positive influence on the rates of change in physical limitations ( $\beta = .23, t = 9.92$ ) but a negative influence on the rates of change in chronic diseases ( $\beta = -.04, t = -2.22$ ), suggesting that older old-adults reported more increasing rates of change in physical limitations but more decreasing rates of change in chronic diseases than younger old-adults.

Gender (i.e., female) had positive influences on the initial levels of physical limitations ( $\beta = .06, t = 2.55$ ) and depressive symptoms ( $\beta = .14, t = 7.50$ ), suggesting that older women reported more physical limitations and depressive symptoms at the baseline than older men. However, gender had a negative influence on the rates of change in chronic diseases ( $\beta = -.06, t = -3.09$ ), suggesting that older women reported more decreasing rates of change in chronic diseases than older men.

Marriage had negative influences on the initial levels of physical limitations ( $\beta = -.09, t = -3.39$ ), chronic diseases ( $\beta = -.05, t = -2.23$ ), and depressive symptoms ( $\beta = -.07, t = -2.89$ ), suggesting that married older adults reported lower numbers of physical limitations, chronic diseases, and depressive symptoms at the baseline than unmarried older adults. Marriage also had a negative influence on rates of changes in physical limitations ( $\beta = -.08, t = -2.67$ ), suggesting that married older adults reported more decreasing rates of change in physical limitations than unmarried older adults.

Ethnicity/race (i.e., African Americans) had positive influences on the initial levels of physical limitations ( $\beta = .08, t = 3.83$ ), chronic diseases ( $\beta = .08, t = 4.90$ ), and depressive symptoms ( $\beta = .13, t = 6.89$ ), suggesting that African-American older adults reported more physical limitations, chronic diseases, and depressive symptoms at the baseline than White older adults. Ethnicity/race (i.e., African Americans) also had a positive influence on rates of change in physical limitations ( $\beta = .04, t = 1.96$ ), suggesting that African-American older adults reported more increasing rates of change in physical limitations than White older adults.

Ethnicity/race (i.e., Hispanic Americans) had positive influences on the initial levels of physical limitation ( $\beta = .10, t = 4.99$ ) and depressive symptoms ( $\beta = .18, t = 9.70$ ), suggesting that Hispanic older adults reported more physical limitations and depressive symptoms at the baseline than White older adults. Ethnicity/race (i.e., Hispanic Americans) also had a negative influence on rates of change of depressive symptoms ( $\beta = -.06, t = -2.70$ ), suggesting that Hispanic older adults reported more decreasing rates of change in depressive symptoms than White older adults.

Table 4. The Influences of Demographic Characteristics and Ethnicity/Race on Trajectories of Physical Limitations, Chronic Diseases, and Depressive Symptoms in Late Adulthood without SES (Standardized Regression Coefficients, *t*-values in Parentheses)

Variable	Physical Limitations		Chronic Diseases		Depressive Symptoms	
	Level	Slope	Level	Slope	Level	Slope
Age	-.01 (-.42)	.23*** (9.92)	.05** (2.80)	-.04* (-2.22)	.05* (2.31)	-.02 (-.72)
Female	.06* (2.55)	-.05 (-1.95)	-.03 (-1.68)	-.06** (-3.09)	.14*** (7.50)	.03 (1.06)
Married	-.09*** (-3.39)	-.08** (-2.67)	-.05* (-2.23)	-.03 (-1.23)	-.07* (-2.89)	-.02 (-.65)
Black	.08*** (3.83)	.04* (1.96)	.08*** (4.90)	-.03 (-1.94)	.13*** (6.89)	-.01 (-.42)
Hispanic	.10*** (4.99)	.04 (1.54)	-.02 (-1.47)	-.03 (-1.63)	.18*** (9.70)	-.06* (-2.70)

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

### ***Testing Model of Demographic Characteristics and Race/Ethnicity with SES***

Table 4 shows the results of the influences of demographic characteristics and socioeconomic status on number of physical limitations, chronic diseases, and depressive symptoms. Factor loadings of socioeconomic status are acceptable (.67 and .72) and presented in Figure 13. Socioeconomic status had negative influences on the initial levels of physical limitations ( $\beta = -.27, t = -7.57$ ), chronic diseases ( $\beta = -.21, t = -7.38$ ), and depressive symptoms ( $\beta = -.44, t = -14.10$ ), suggesting that lower SES older adults reported more physical limitations, chronic diseases, and depressive symptoms at the baseline than higher SES older adults. Socioeconomic status also had negative influences on rate of changes in physical limitations ( $\beta = -.11, t = -2.37$ ) and depressive symptoms ( $\beta = -.16, t = -3.27$ ), suggesting that lower SES older adults reported more increasing rates of change in physical limitations and depressive symptoms than higher SES older adults.

After adding SES to the model, most of the influences of demographic factors and ethnicity/race diminished reflecting confounding with SES. In this comprehensive model, age had a positive influence on the rates of change in physical limitations ( $\beta = .22, t = 9.54$ ), suggesting that older old-adults reported more increasing rates of change in physical limitations. Gender (i.e., female) had a negative influence on the initial levels of chronic diseases ( $\beta = -.05, t = -2.74$ ) but a positive influence on the initial levels of depressive symptoms ( $\beta = .10, t = 5.24$ ), suggesting that older women reported fewer chronic diseases but more depressive symptoms than older men. Gender (i.e., female) also had negative influences on the rates of change in physical limitations ( $\beta = -.05, t = -2.21$ ) and chronic diseases ( $\beta = -.05, t = -2.91$ ), suggesting older women reported more decreasing rates of change in physical limitations and chronic diseases than older men. Marriage had a positive

influence on the initial levels of depressive symptoms ( $\beta = .06, t = 2.40$ ), suggesting that married older adults reported more depressive symptoms at the baseline than unmarried older adults. Ethnicity/race (i.e., Hispanic Americans) had negative influences on the initial levels of chronic diseases ( $\beta = -.11, t = -5.54$ ) and on the rates of change of depressive symptoms ( $\beta = -.12, t = -3.73$ ), suggesting that Hispanic older adults reported fewer chronic diseases at the baseline and more decreasing rates of change in depressive symptoms, compared to their White counterparts.

Table 5. The Influences of Demographic Characteristics and Ethnicity/Race on Trajectories of Physical Limitations, Chronic Diseases, and Depressive Symptoms in Late Adulthood when SES is added (Standardized Regression Coefficients, *t*-values in Parentheses)

Variable	Physical Limitations		Chronic Diseases		Depressive Symptoms	
	Level	Slope	Level	Slope	Level	Slope
Age	-.03 (-1.52)	.22*** (9.54)	.03 (1.73)	-.04 (-1.95)	.01 (.25)	-.03 (-1.16)
Female	.03 (1.47)	-.05* (-2.21)	-.05** (-2.74)	-.05** (-2.91)	.10*** (5.24)	.02 (.83)
Married	-.01 (-.27)	-.05 (-1.59)	.02 (.67)	-.04 (-1.77)	.06* (2.40)	.02 (.65)
Black	-.002 (-.07)	.02 (.70)	.02 (1.04)	-.02 (-.98)	-.003 (-.13)	-.05 (-1.86)
Hispanic	-.01 (-.56)	-.01 (-.17)	-.11*** (-5.54)	-.01 (-.29)	-.01 (-.52)	-.12*** (-3.73)
SES	-.27*** (-7.57)	-.11* (-2.37)	-.21*** (-7.38)	.06 (1.74)	-.44*** (-14.10)	-.16*** (-3.27)

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

Graphical analyses also illustrate the results of the growth curve models, demonstrating the cumulative influences of socioeconomic status on health problems. Graphics for low and high SES groups reflect that the sum scores of standardized education and standardized household income were divided into low and high SES groups by the median. Older adults from low SES had higher initial levels and rates of change in number of physical limitations, compared to older adults from high SES (see Figure 5). Older adults from low SES had consistently higher levels of chronic diseases than those from high SES. Although older adults from high SES group had higher rates of change in number of chronic diseases than those from low SES group, the differences were not significant (see Figure 6). In addition, while older adults from low SES reported more than twice the levels of depressive symptoms than their counterparts from high SES, older adults from high SES had similar rates of change in number of depressive symptoms over time, compared to their counterparts in the low SES (see Figure 7).

Although analyses of the multivariate growth curve models provided evidence for divergent trajectories based on socioeconomic status, only some of the results shown in the analyses of the multivariate growth curve models are also represented in the figure for the bivariate relationships between SES and physical limitations.

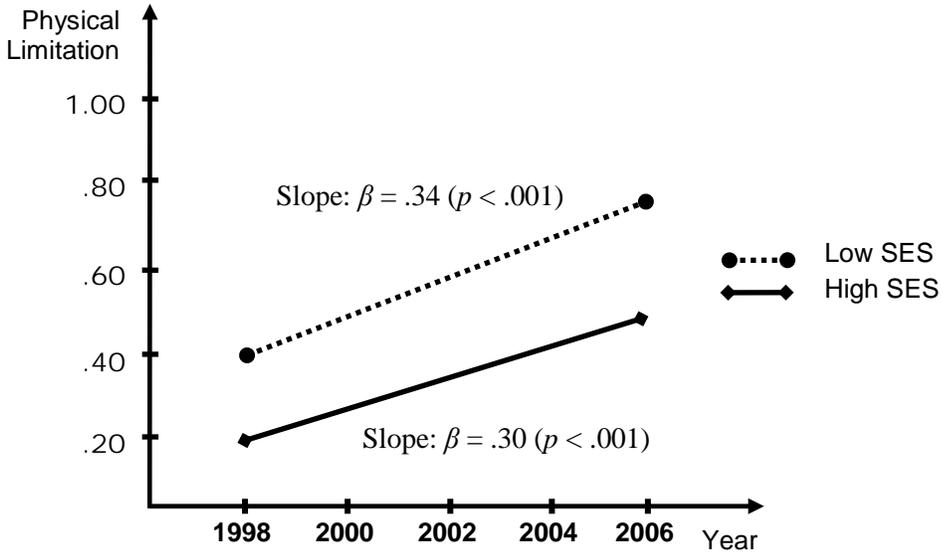


Figure 5. Cumulative Influences of SES on Physical Limitations.

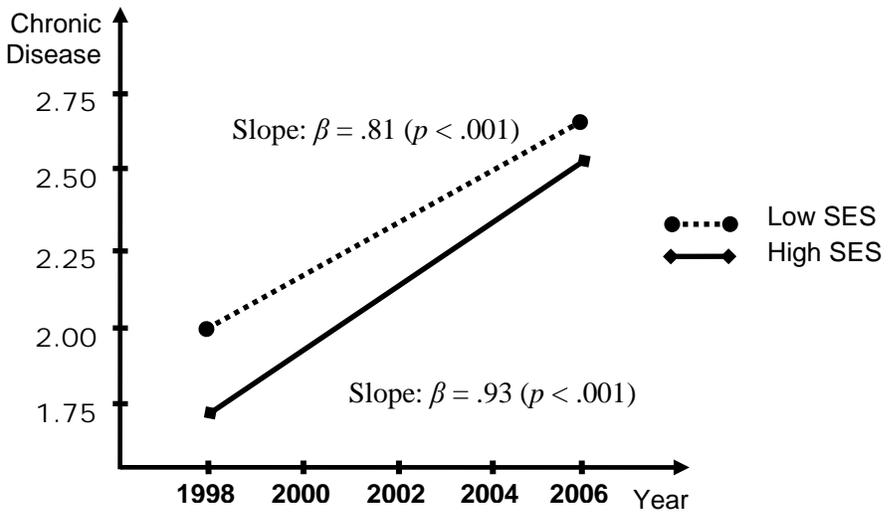


Figure 6. Cumulative Influences of SES on Chronic Diseases.

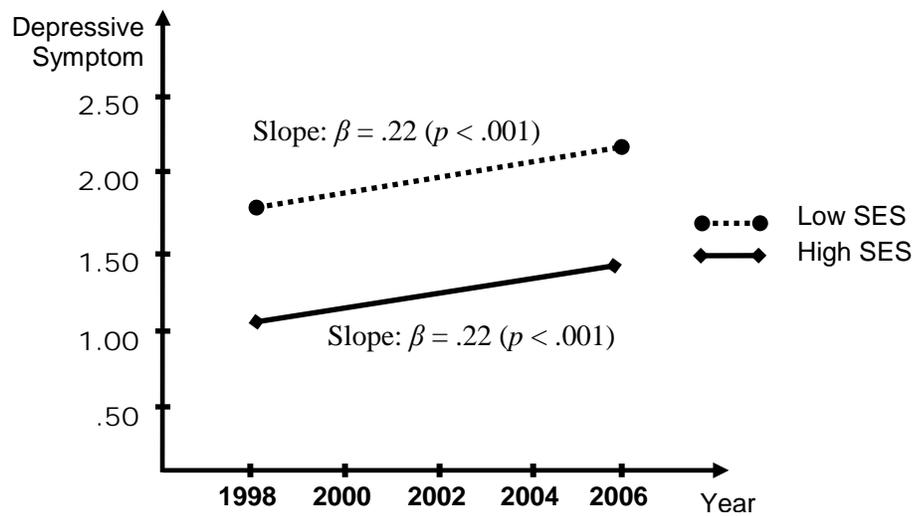


Figure 7. Cumulative Influences of SES on Depressive Symptoms.

Graphical plots also demonstrated the cumulative influences of demographic and ethnic/racial characteristics on trajectories of health problems.

First, age influenced the rates of change in physical limitations and chronic diseases. Old-old adults had higher initial levels and rates of change in physical limitations compared to young-old adults (see Figure 8), suggesting old-old adult experiencing a faster increasing rate of physical malfunctioning. Old-old adults had higher initial levels but slower rates of change in chronic diseases, compared to young-old adults (see Figure 9), suggesting young-old adults experience a faster rate of onset of new chronic diseases (an equalization).

Gender also influenced the rates of change in physical limitations and chronic diseases. Older men had slightly higher rates of change in physical limitations than older women although older women had higher levels of physical limitations (see Figure 10). Older men had higher initial levels and rates of change in chronic diseases than older women (see Figure 11).

Finally, ethnicity/race (i.e., Hispanic Americans) influenced the rates of change in number of depressive symptoms. As presented in Figure 12, non-Hispanic White older adults reported higher rates of change in number of depressive symptoms than Hispanic older adults. Although it was not statistically significant in the conceptual model of this study, however, Hispanic older adults reported consistently high mean levels of depressive symptoms over time compared to non-Hispanic White older adults.

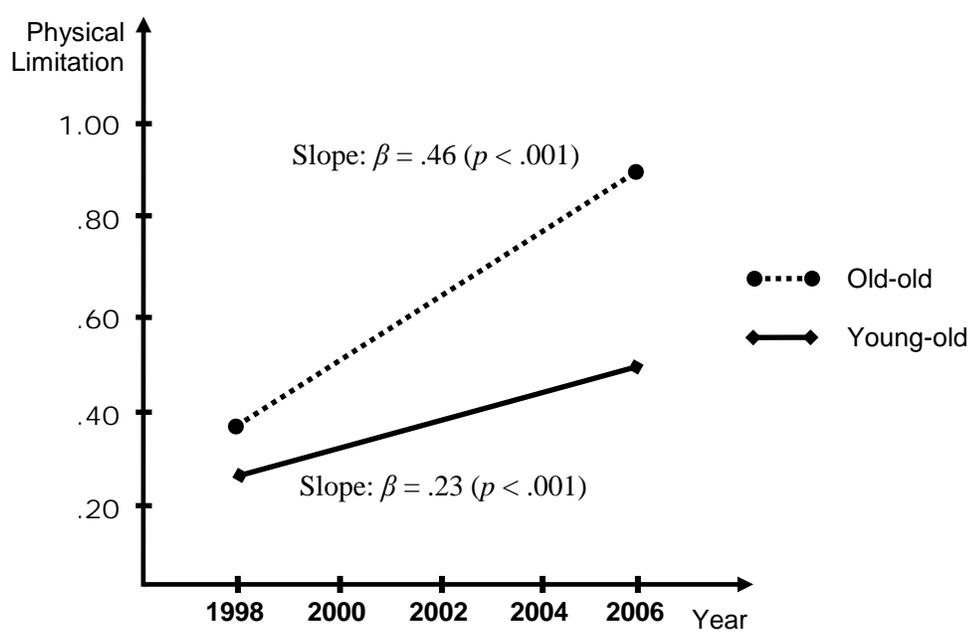


Figure 8. Cumulative Influences of Age on Physical Limitations.

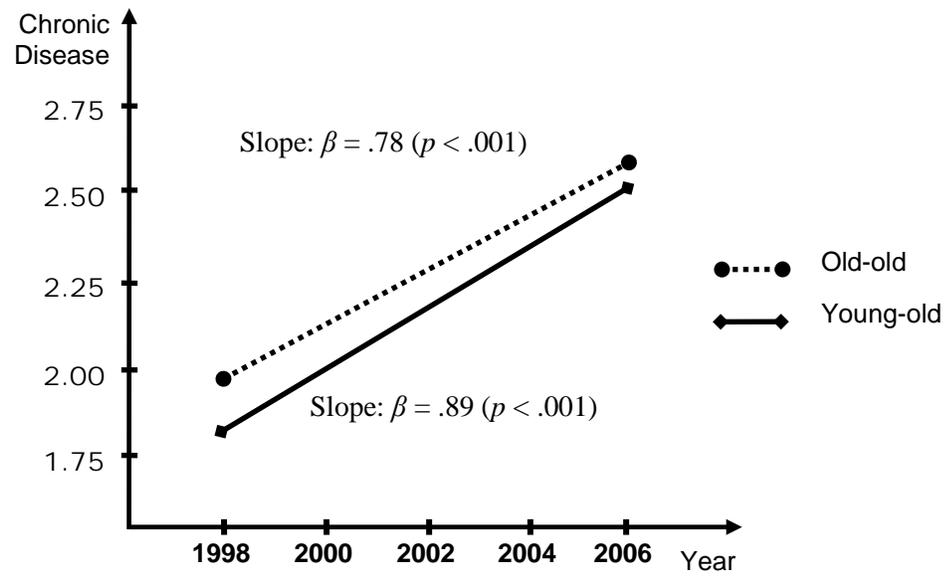


Figure 9. Cumulative Influences of Age on Change in Chronic Diseases.

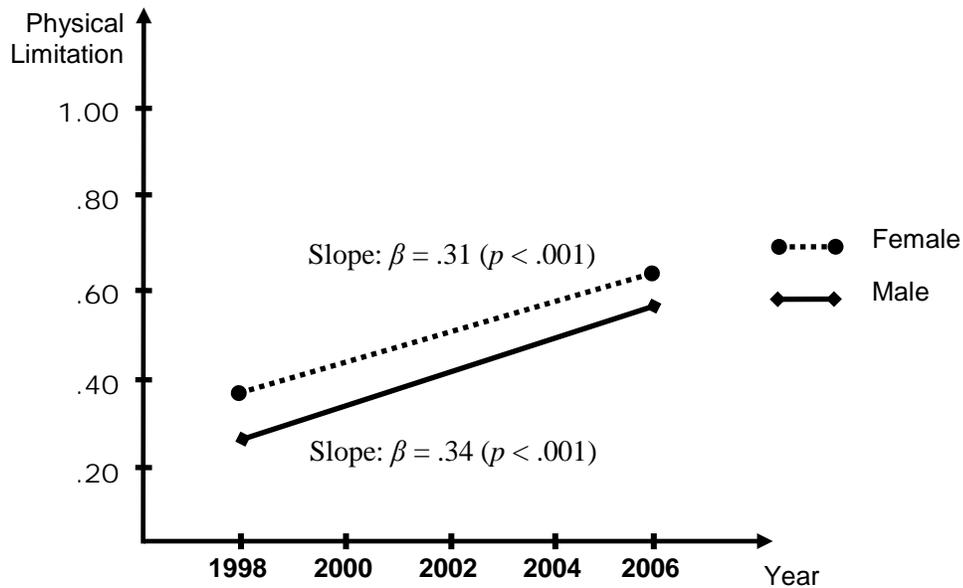


Figure 10. Cumulative Influences of Gender on Physical Limitations.

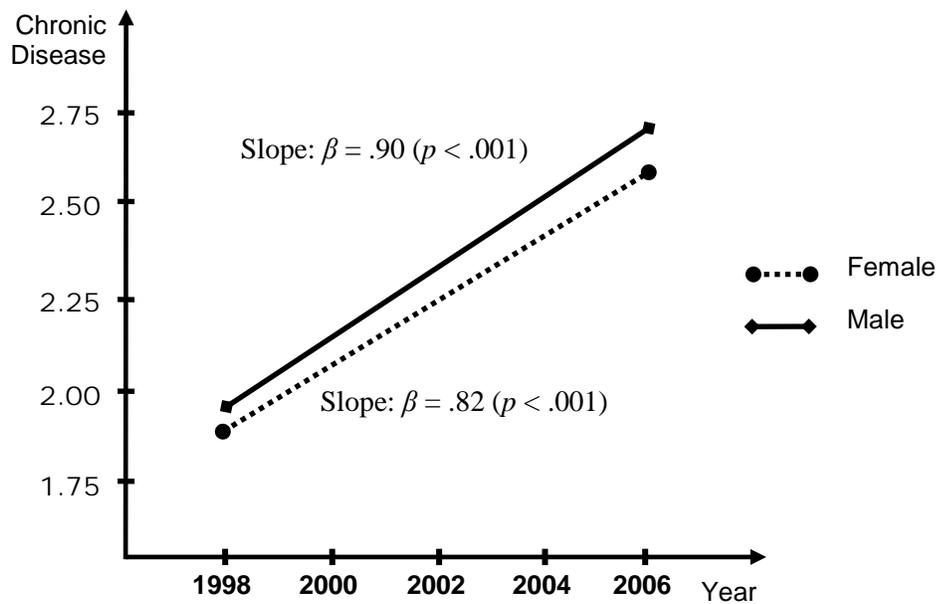


Figure 11. Cumulative Influences of Gender on Change in Chronic Diseases.

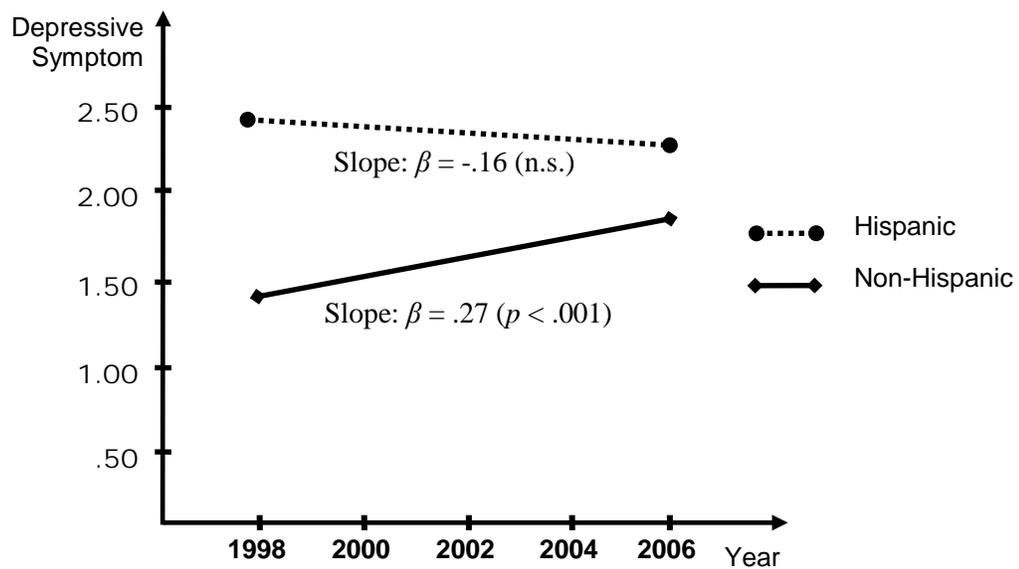
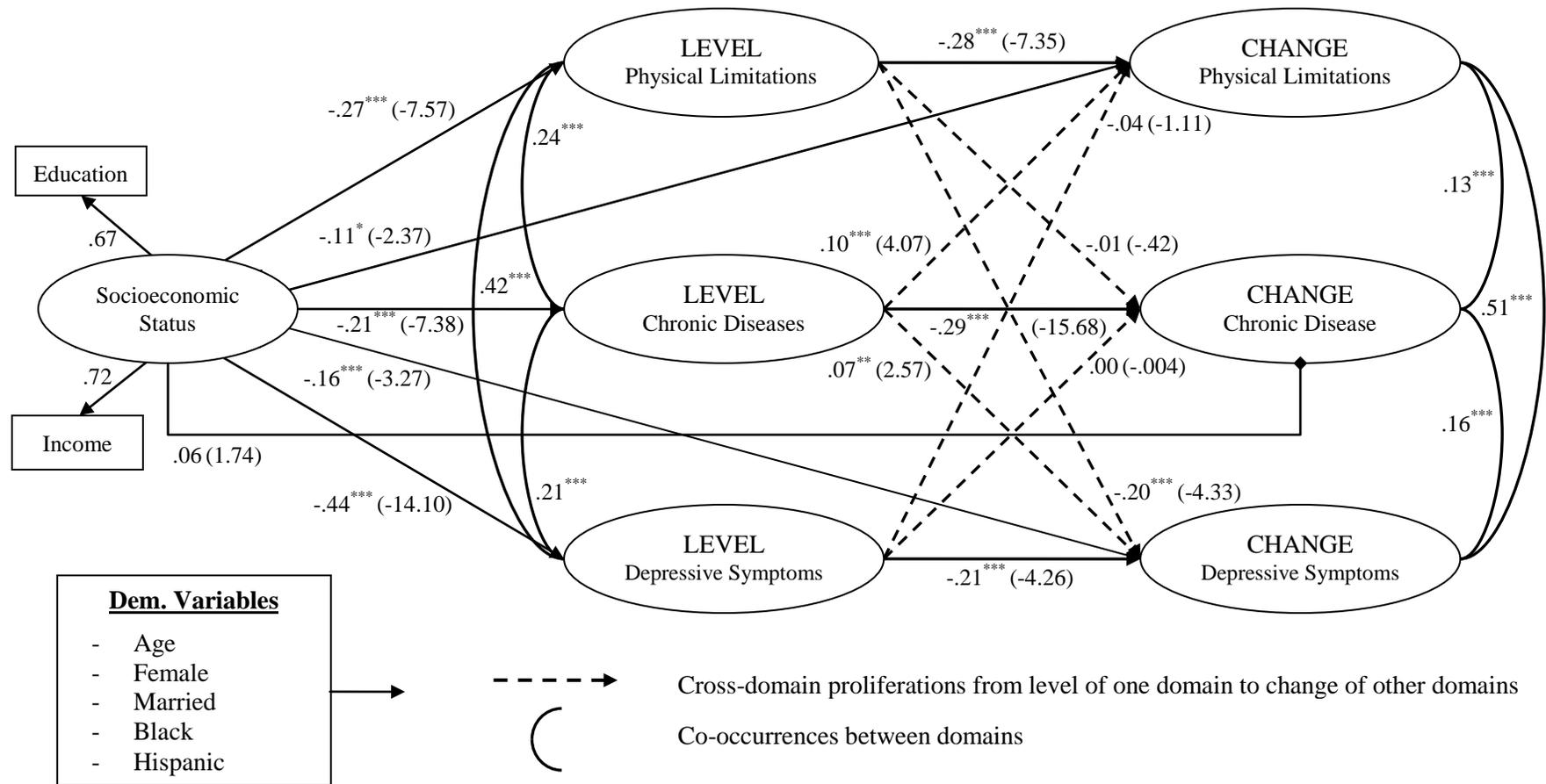


Figure 12. Cumulative Influences of Hispanic on Depressive Symptoms.

Figure 13 shows the results of cross-domain influences between physical limitations, chronic diseases, and depressive symptoms over time. Levels of physical limitations, chronic diseases, and depressive symptoms were negatively associated with the rates of change in physical limitations ( $\beta = -.28, t = -7.35$ ), chronic diseases ( $\beta = -.29, t = -15.68$ ), and depressive symptoms ( $\beta = -.21, t = -4.26$ ), respectively. Older adults who had higher levels of physical limitations showed slower rates of change in number of physical limitation; older adults who had higher levels of chronic diseases showed slower rates of change in number of chronic diseases; and older adults who had higher levels of chronic diseases showed slower rates of change in number of chronic diseases.

Levels of physical limitations, chronic diseases, and depressive symptoms were positively correlated one another, suggesting that older adults who had higher levels of one health problem showed higher levels of other problems. In addition, the rates of change in number of physical limitations, chronic diseases, and depressive symptoms were positively correlated one another, suggesting that older adults who had faster rates of change in one health problem showed faster rates of change in other problems.

Levels of physical limitations negatively predicted the rates of change in depressive symptoms ( $\beta = -.20, t = -4.33$ ), suggesting that older adults who had higher levels of physical limitations showed slower rates of change in number of depressive symptoms. Furthermore, levels of chronic diseases positively predicted the rates of change in physical limitations ( $\beta = .10, t = 4.07$ ) and depressive symptoms ( $\beta = .07, t = 2.57$ ), suggesting older adults who had higher levels of chronic diseases showed faster rates of change in number of physical limitations and depressive symptoms. The model fit well with the data,  $\chi^2(166) = 2168.08$ , CFI = .95, RMSEA = .05, and SRMR = .03.



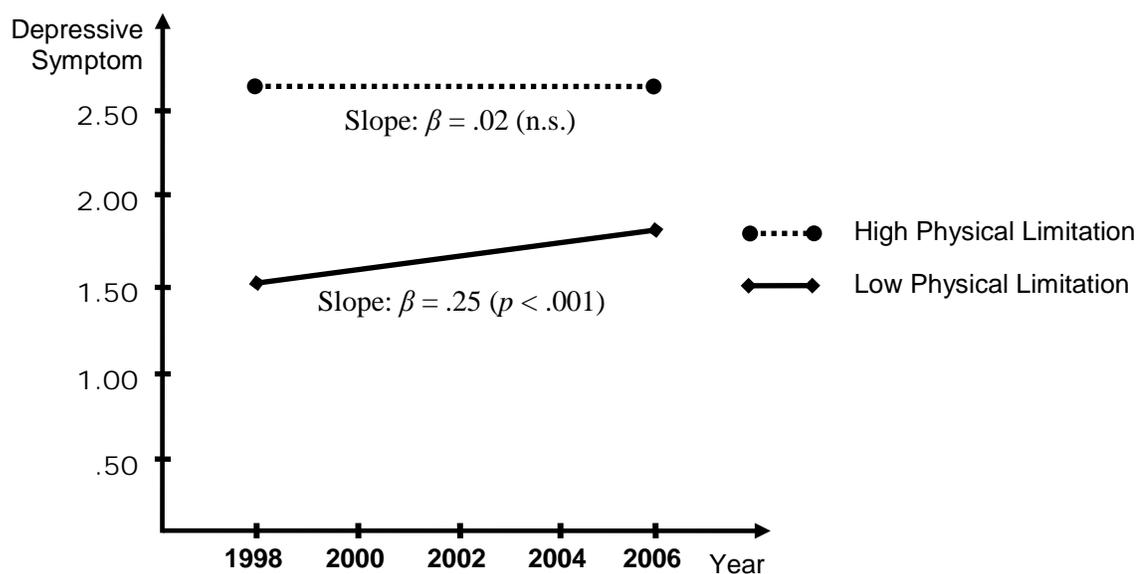
$\chi^2 (166) = 2168.08$ , CFI = .95, RMSEA = .05, SRMR = .03

Figure 13. Socioeconomic Status and Trajectories of Physical Limitations, Chronic Diseases, and Depressive Symptoms in Late Adulthood, Controlling for Demographic Characteristics (Standardized Regression Coefficients, *t*-values in Parentheses).

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

As presented in Figure 13, the initial levels of physical limitations negatively predicted the slope of depressive symptoms in late adulthood. Because these findings were contrary to the expectation, an additional analysis was performed as shown in Figure 14. The results showed that older adults with no physical limitations reported increasing rates of change in number of depressive symptoms over time whereas older adults with physical limitations reported constant rates of change in number of depressive symptoms over time; that is, because physically limited older adults at the baseline were likely to report the highest levels of depressive symptoms, there were no more increases in number of depressive symptoms over the life course (a ceiling effect).



*Figure 14.* Cross-Domain Influences of Physical Limitation on Change of Depressive Symptoms.

## CHAPTER 5. DISCUSSION

The primary research objective of the present study was to explore whether socioeconomic (i.e., education and income) as well as demographic (i.e., age, gender, marital status, and ethnicity/race) characteristics significantly predict the initial levels and rates of change in number of physical limitations, chronic diseases, and depressive symptoms among adults over 65 years old. Another research objective was to investigate whether the initial levels of one specific health problem predict rates of change (slopes) in another health problem and whether the levels and rates of change of different health problems covary. Findings of this study indicate the long-term influences of socioeconomic status on a) the levels (severity), and b) the slopes (rates of change) in health problem trajectories during old adulthood, reflecting a cumulative influence of SES. In addition, the initial level of a health problem influenced the change in another health problem over time and levels and rates of change in a number of physical limitations, chronic diseases, and depressive symptoms covaried among one another, supporting the notion of a stress-manifestation or health proliferation process over late adult years.

### *Implications of Findings on Existing Literature*

#### *Question 1. Demographic and Socioeconomic Characteristics and Health Problems*

##### *The Influences of Demographic Characteristics on Health Problems*

Results of this study show important gender differences in health trajectories in later life. Older women reported higher initial levels of number of depressive symptoms but older men reported higher initial levels and rates of change in number of chronic diseases over

time. This study is consistent with previous studies indicating that older women did not report more chronic diseases than men (Denton et al., 2004), showing a more biological robustness or less physical fragility than older men. In addition, this study is consistent with previous studies documenting that older women reported more mental health problems than older men. In other words, gender differences in health status are different depending on health domains.

Marriage had a negative influence on the initial number of physical limitations, chronic diseases, and depressive symptoms and on rates of change in number of physical limitations. In other words, married older adults report better health than unmarried older adults over time. These findings are consistent with marital health studies, documenting the beneficial effects of marriage on short-term and long-term health in late adulthood. Marriage provides greater financial resources as well as stable social support necessary to maintain healthy life styles and better health over the life course (Umberson, 1992; Wickrama et al., 2006), whereas unmarried older adults are more likely to be exposed to more disadvantages and strains, which leads to be vulnerable over time (Dupre & Meadows, 2007).

The study also showed important ethnicity/race influences on health in later life. African Americans had more physical limitations, chronic diseases, and depressive symptoms and higher rates of change in number of physical limitations than White older adults. Hispanic Americans had a higher initial number of physical limitations and of depressive symptoms but lower rates of change in number of depressive symptoms compared to White older adults. In additional analyses for cumulative influences of Hispanic minority status on a number of depressive symptoms, we found that because Hispanic older adults at

the base line were likely to report the highest number of depressive symptoms, there was no room for further increases in number of depressive symptoms over time (a ceiling effect).

These results are consistent with previous studies (Bzostek, Goldman, & Pebley, 2007; Williams, 2005) documenting that Blacks and Hispanics were more likely to report poor self-rated health compared to their White counterparts. These minority health gaps may be attributed to their lower levels of human capital, less access to services, and systematic day-to-day discrimination (Brown, 2002; William, 2005).

More importantly, most of the observed ethnicity/race influences on health outcomes diminished when SES was added to the model. This may be attributed to the fact that ethnicity/race minority status is confounded with socioeconomic variables. Ethnic/racial minorities are socioeconomically disadvantaged. That is, in old age, there are diminished unique health influences of ethnic/racial minority status over and above SES influences. Similarly, the influence of marital status also diminished when SES was added to the model indicating that, in old age, marital status was also confounded with SES. High SES older adults may be more likely to remain married compared to low SES old adults.

#### *The Influences of Socioeconomic Status on Health Problems*

The present study found that socioeconomic status at baseline influenced the initial levels of number of physical limitations, chronic diseases, and depressive symptoms clearly reflecting SES gradients in these health conditions in old age. More importantly, SES at the baseline influenced rates of change (slopes) in these health problems reflecting variations in SES inequalities in health in late adulthood, demonstrating the cumulative influences of SES

on health problems. Thus, findings of this study indicate the crucial roles of socioeconomic status in determining long-term health among adults over 65 years old.

Socioeconomic status has strong influences on trajectories of multiple health problems over time, supporting the notion that socioeconomic status is a fundamental cause of health (Link & Phelan, 1995). Consistent with previous studies (Lantz et al., 2001; Phelan et al., 2004; Warren & Herbabdez, 2007; Wray et al., 2005), the present study revealed that individuals with low SES are likely to show higher levels of poor health than their advantaged counterparts. These SES health gaps reflect the resource gaps between low and high SES groups of older adults because health outcomes are closely associated with socioeconomic resources. Consistent with the cumulative disadvantage perspective, this association is not merely contemporaneous but also a result of accrual of lack of socioeconomic resources throughout the life course (Dannefer, 2003).

Especially, findings of the present study indicate the divergent effects of socioeconomic status on a number of physical limitations; in other words, older adults with the higher socioeconomic groups maintain relatively lower number of physical limitations over time, whereas those with the lower socioeconomic groups continue to increase number of physical limitations over time. The reason of these diverging effects of SES on number of physical limitations was the differentiation in exposure to the chains of risks and in the deprivations of resources between low SES and high SES groups with increasing age (Dannefer, 2003; Phelan et al., 2004). For example, low socioeconomic status groups are likely not only to take higher unhealthy behaviors and more chronic and acute stress but also to have lower medical expense and limited social support compared to high socioeconomic

status groups (House et al., 1994). Therefore, this increasing divergence in exposure to the chains of risks and in the deprivations of resources between SES groups may explain the long-term differentiation of number of physical limitations between SES groups in late adulthood.

### *Question 2. Inter-related Processes of Different Health Domains*

Another objective of this study was to demonstrate the longitudinal cross-domain influences as well as the contemporaneous associations in different health problems.

#### *Cross-domain Influences of Different Health Domains*

First, initial number of chronic diseases influenced rates of change in number of physical limitations and of depressive symptoms, apparently an effect of chronic diseases across different domains in health (Alexopoulos et al., 1996; Aneshensel et al., 1984; Ormel et al., 2002; Verbrugge & Jette, 1994). It appears that a number of chronic diseases which older adults experience may contribute to health decline in other domains in late adulthood. This is consistent with the proliferation notion of the stress theory: health problems proliferate across domains (Pearlin et al., 2005). Specifically, chronic diseases produce impairments of physical capacities such as strength, mobility, and manual dexterity; in addition, chronic diseases may produce stressful conditions through medical processes such as medical expense and psychological distress such as feeling worthless or hopeless, which in turn increases mental health problems (Ormel et al., 2002). And this is also consistent with the life course notion of “chain of risks” over the life course (O’Rand & Hamil-Luker, 2005), suggesting that early disadvantages influence early risks which would in turn influence later

risks creating a “chain of risks” over the life course. Thus, the present study demonstrated the dynamic interrelated health processes over the adult years stemming from early socioeconomic conditions.

Contrary to the expectation, initial number of physical limitations negatively influenced rates of change in number of depressive symptoms among older adults, suggesting that older adults with fewer physical limitations reported increasing rates of change in number of depressive symptoms over time whereas older adults with more physical limitations maintained consistently high level of depressive symptoms without substantial changes over time (a ceiling effect). In fact, number of depressive symptoms in older adults with high levels of physical limitations was almost twice as high when compared to those older adults with low levels of number of physical limitations. However, findings of this study suggest that even older adults who have enjoyed better health experience health problems or psychological distress sooner or later (Schieman & Plickert, 2007).

Interestingly, the present study does not find evidence for a causal influence of depressive symptoms on other health problems in late adulthood. These findings are inconsistent with several previous studies (e.g., Ormel et al., 2002), which documented that depressive symptoms have significant lagged effects on disability. The reasons for these inconsistent findings may be due to the use of different measures of depressive symptoms and different methodologies (cross-lagged vs. latent growth curve). The absence of an effect of depressive symptoms on physical health may also be attributed to the fact that, as Aneshensel and colleagues (1984) asserted, depressive symptoms have a delayed and weaker effect on physical health. Further, our sample showed relatively better mental health

compared to the total sample of the study; that is, clinically severe depressive symptoms or depressive disorders may contribute to physical health decline.

### *Inter-locking Trajectories of Different Health Domains*

The final objective of the present study was to explore the inter-locking trajectories of different health domains. Findings of this study identified that initial numbers of physical limitations, chronic diseases, and depressive symptoms were positively correlated one another. In other words, older adults with higher number of one specific health problem at the baseline are likely to report more other health problems at the baseline. Furthermore, rates of changes in number of physical limitations, chronic diseases, and depressive symptoms were also positively correlated with one another. It means that older adults with higher rates of change in one specific health problem are likely to report higher rates of changes in other health problems over time. These inter-locking trajectories of health problems support the importance of mutual processes across different health domains.

In summary, findings of the present study support the important role of socioeconomic status on health trajectories and the longitudinal cross-domain influences as well as the contemporaneous associations in different health problems (e.g., physical limitations, chronic diseases, and depressive symptoms). Because health decline is a multidimensional process (Kelley-Moore & Ferraro, 2005), the present study may be useful in understanding the relationships between different domains of health decline among older adults by investigating cross-domain and contemporaneous associations between physical limitations, chronic diseases, and depressive symptoms. Although health decline is a process

that occurs over several years rather than instantaneously (Kelley-Moore & Ferraro, 2005), previous studies were cross-sectional or relatively short-term longitudinal. However, the present study investigated long-term trajectories of health decline over a period of 10 years. Therefore, results of this study would contribute to the understanding of a long-term process of multidimensional health decline in late adulthood.

### *Limitations of this Study*

Caution needs to be exercised in interpreting the results of this study because there are some limitations to the present study. First, attrition is one of the limitations of this study. As this is a longitudinal study over a period of 10 years in older adults, attrition is due to mortality or any other reasons. Because attrition would be potentially associated with selective attrition bias, attrition especially related to mortality could significantly affect findings of this study. However, possible mortality selection would lead to underestimation of findings of this study (Lynch, 2003; Kim & Durden, 2007). For example, because mortality is likely to reduce diverging and persistent SES-gaps in health problems and the effects of co-morbid health problems over time, it would reduce the reciprocal influences of health problems (Ormel et al., 2002). As a result, even with a potential mortality selection bias, findings of this study would be still support cumulative influences of socioeconomic status on health and cross-domain influences of different health domains.

Another limitation is that the present study used self-reported measures of SES and health problems. By using self-reported measures, this study does not assess the bias due to reporting error (Kennedy, Paeratakul, Ryan, & Bray, 2007). Although self-reported measures

in health are reliable and valid (Centers for Disease Control and Prevention, 2000), recent research with respect to physical limitations has begun to use performance-based measures by observing participants' task performance of activities (Verbrugge & Jette, 1994). Thus, future research should examine these associations using more objective measures as well as self-reported measures for a better understanding of these associations.

### ***Policy Implications***

The results presented here make an important contribution by demonstrating long-term health consequences due to socioeconomic status in later life. These influences are over and above the influences of demographic and ethnic/race characteristics. Although policy programs such as the Medicare program would reduce unequal accessibility to health care for older adults from low SES groups, for example, socioeconomic differences in health still exist due to the recent increasing rates of supplemental insurance (Huguet, Kaplan, & Feeny, 2008). Thus, policies and programs should pay more attentions towards reducing socioeconomic adversity by recognizing the health consequences of long-term exposure to socioeconomic adversity.

In addition, findings of this study elaborate the progression of related health processes involving several proliferations and reciprocities in later life. For instance, because chronic diseases are considered as health risks for physical limitations and depressive symptoms among older adults, primary prevention before onset of chronic diseases would be the most effective prevention to maintain a healthy life (Verbrugge & Jette, 1994). Furthermore, early detection and appropriate treatment for chronic diseases also prevent older adults from other

health problems such as physical limitations and depressive symptoms (Verbrugge & Jette, 1994). As a result, a better understanding of these processes aids in the formation and effective prevention and implementation of physical and mental health promotion programs for older men and women, which leads older adults to sustain an independent and healthy life.

## APPENDIX A: STATEMENT FROM IRB

**IOWA STATE UNIVERSITY**  
OF SCIENCE AND TECHNOLOGY

Institutional Review Board  
Office for Responsible Research  
Vice President for Research  
1138 Pearson Hall  
Ames, Iowa 50011-7707  
515 281-4586  
FAX 515 281-4757

**Date:** October 1, 2009

**To:** Kyung Hwa Kwag  
215 Sinclair Ave. #108  
Ames, IA 50014

**CC:** Jacques Lempors  
4380 Palmer, Suite 2361D

**From:** Roxanne Bappe, IRB Coordinator  
Office for Responsible Research

**Project Title:** **The Cumulative Influences of Socioeconomic Status on Health Outcomes in Late Adulthood: A Latent Growth Curve Analysis**

**IRB ID:** 09-453

The Co-Chair of the ISU Institutional Review Board has reviewed the project noted above and determined that the project:

- Does not meet the definition of research according to federal regulations.
- Is research that does not involve human subjects according to federal regulations.

Accordingly, **this project does not need IRB approval and you may proceed at any time.** We do, however, urge you to protect the rights of your participants in the same ways you would if IRB approval were required. For example, best practices include informing participants that involvement in the project is voluntary and maintaining confidentiality as appropriate.

Please also know that **any change** to this project must be communicated to the IRB to determine if the project has become research with human subjects requiring IRB approval.

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