

Diabetes Health and Disability Pathways: Racial/Ethnic, Socioeconomic, and Gender
Disparities

by

Emily Joy Nicklett

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Sociology and Health Services Organization and Policy)
in The University of Michigan
2010

Doctoral Committee:

Professor Jersey Liang, co-chair
Associate Professor Renée R. Anspach, co-chair
Professor Pamela J. Smock
Associate Professor Jane C. Banaszak-Holl
Assistant Professor Sarah A. Burgard
Research Professor Caroline S. Blaum

© Emily Joy Nicklett

2010

To my mother:

I am who I am because you are who you are

Acknowledgements

There were many people who provided expertise, guidance, and social/tangible support to help guide me along this journey. First, I thank members of my dissertation committee: Renée Anspach has been a brilliant dissertation co-chair, advocate, source of helpful critique and encouragement, and a dear friend. I am grateful to her for introducing me to sociology and to qualitative methods. Jersey Liang (co-chair) has provided me with the enthusiasm to study social gerontology and to seek methodologies from which I would have previously gone into hiding, he encouraged ambition yet helped me maintain practical goals. Finally, his sense of humor and laugh are unique and unforgettable and make every load seem lighter. Thanks are also due to Sarah Burgard, who I deeply admire. Throughout my doctoral education, Sarah eased me into professional development from many fronts—in teaching, being taught, co-authorship, and mentorship. I have learned so much from her and feel there remains so much to learn. I greatly appreciated her generosity and commitment to my work. I am also grateful to Caroline Blaum for her most helpful feedback and for providing insight from a provider's perspective—which was invaluable for helping me navigate the job market process. Jane Banaszak-Holl helped me understand the importance of transdisciplinary research and what it means to be a health services researcher. Pamela Smock has provided a

demographic perspective and insight for mixed-methods research that will not only enrich this work, but has deeply influenced the perspective from which I view health and aging. I am most grateful to my committee.

Data from the Health and Retirement Study was a critical element in my dissertation research and I want to thank Jessica Faul, Ken Langa, Janet Keller, and Helen Levy for help in understanding the breadth as well as some of the mechanics of working with this excellent data source. I am also most grateful to Lloyd Grieger, Steve Heeringa, Ana Diez Roux, and Brady West for teaching me many of the statistical tools that helped throughout this process. I also would like to thank Linda Nyquist from the Institute of Gerontology for providing information for the qualitative data sample, without which the primary data collection would not have been possible. Of course, the participants themselves have made great contributions to this work.

Marissa Abraham, Talia Barash, Rebecca Halpern, Andrea Imhoff, Jessica Jurek, Sara Kuzminski, Rachel Rifkin and Jane Shim provided superb research assistance. I feel so fortunate to have worked with such brilliant students. This experience continues to give me deep enthusiasm for teaching.

Financial support for my pre-candidate education was generously provided by the Agency for Healthcare Research and Quality (AHRQ) in two predoctoral institutional training grants, through Rackham Graduate School (through a position at Graduate Student Affairs) and through teaching assistantships in the Department of Sociology with

Elizabeth Bruch and Sarah Burgard. As a candidate, I was supported by the Hartford Fellowship for Geriatric Social Work (PI: Jim Lubben), by the National Institute on Aging (PI: Mary Haan), and by the Agency for Healthcare Research and Quality (Individual Dissertation Award). I am most grateful for this generous support, which was helpful for the completion of the dissertation. In addition, I would like to recognize the Center for Integrative Approaches to Health Disparities (PI: Ana Diez Roux, James Jackson) for the pilot grant that funded the primary data collection used in the fourth chapter of this dissertation. Finally, I would like to thank Rackham Graduate School for generous funding of travel grants and other sources of funding over the course of my graduate education.

The students, faculty, and staff in Ann Arbor have provided me with a supportive and intellectually challenging home during the past five years. I am grateful to Professors Daniel Eisenberg and Paula Lantz for their instrumental roles in recruiting me to Michigan and in providing support over the duration of my study. I would also like to thank Connie Rockman, Brenda Bernhardsson, Mindy Niehaus-Fukada, and Jeannie Loughry for being such cheerleaders to doctoral students. This experience was unforgettable due to my bright and shining HSOP cohort: Anda Botoseneanu, Jennifer Hefner, Hsien-Chang Lin, Kamilah Neighbors, Edward Okeke, and Simone Rauscher. I also extend my sincere thanks to Natalie Bartolacci, Amy Eaton, Sarah Gollust, Christina Halldorson, Dan Hirschman, Andrea Janes, Kat Overland, Ana Quiñones, Cameron Shulz, Jolie Terrazas, and particularly to Solomon David for years of friendship and

support (even during the rough tides). Being far away from home I am blessed to have met Solomon David and his family in the Midwest, who have been a tremendous source of support and joy.

I would also like to thank those who have been mentors in both official and unofficial capacities. Through the Hartford Foundation, I was fortunate to form a relationship with Ruth Dunkle, who provided invaluable professional guidance during my academic job search. I have grown much personally through yoga: Jasprit Singh has taught me so much about balance, strength, and flexibility: areas that I hope to further develop as I enter academia. Lois Verbrugge has been an inspiring mentor to me; it has been an honor to work with her and to become friends.

Finally, I want to thank my family for their constant love and encouragement. My parents, Deborah and Gary Nicklett, my sister, Natalie Nicklett, and my grandparents have provided much support and patience for my decision to pursue a PhD. In particular, my mother and father have joined me in the task of learning about academic structures, processes, and outcomes. They have patiently provided encouragement in times of frustration and celebrated in times of success. It is due to them that I never felt alone in this endeavor. For that, I am eternally grateful.

Table of Contents

Dedication	ii
Acknowledgements.....	iii
List of Tables	viii
Abstract.....	ix
Chapter 1: Introduction.....	1
Chapter 2: Diabetes-Related Support, Regimen Adherence and Health Decline among Older Adults.....	36
Chapter 3: Health Decline in Older Adults with Diabetes: Are Race/Ethnicity and Socioeconomic Status Independent Predictors of Long-term Outcomes?	65
Chapter 4: Gender, Health Behaviors, and the Paradox of Social Ties: A Mixed-Method Examination of Functional Decline among Mid- and Late-Life Diabetics.....	99
Chapter 5: Conclusion.....	162

List of Tables

Table 2.1: Distribution of Study Variables in HRS Population.....	52
Table 2.2: Logistic Regression Analysis of the Probability of Health Status Decline	54
Table 2.3: Ordinal Logit Analyses of Social Support on Regimen Adherence	56
Table 3.1: Distribution of Self-Rated Health by Health Status	81
Table 3.2: Distribution of Self-Rated Health by Race/Ethnicity	83
Table 3.3: Multi-level Proportional-Odds Models Predicting Self-Rated Health	85
Table 4.1: Distribution of Sample Characteristics by Gender	119
Table 4.2: Functional Status by Gender (1999-2008).....	125
Table 4.3: Functional Status and Gender Interactions (1999-2008).....	127

Abstract

Diabetes and its complications continue to be a national health and social policy concern, particularly among older adults. More research is needed to identify mechanisms through which social disparities in disease outcomes develop and compound. The broad goal of this proposed research is to examine disparities in the long-term health and disability outcomes associated with diabetes in mid and late life.. This dissertation aims to (1) examine how social statuses relate to rate and steepness of health decline among older diabetics and to (2) determine the extent to which certain protective factors, such as social support, operate as mediators in this relationship. Based on previous research, particular attention is given to the role of social factors (such as disease related support, social support, and other forms of social ties) in mediating these processes. The outcomes examined are self-reported health status, adherence, and functional limitations. The hypotheses tested are that individuals with less social support—as well as individuals from socially disadvantaged backgrounds—will report lower health status and greater functional limitations relative to individuals from socially privileged backgrounds and relative to individuals greater amounts of social support.

To accomplish these specific aims, longitudinal survey data is examined from the Health and Retirement Study (HRS) along with the 2003 HRS Diabetes Supplement.

Further, qualitative and quantitative data were collected and analyzed from a small sample (30) of community-dwelling seniors. Multi-level modeling and mixed-method analysis is used to examine individual-level patterns of change.

This series of analysis suggests that race/ethnicity, socioeconomic status, and gender were independent predictors of subsequent health and disability outcomes. However, additional characteristics, such as social support and health characteristics, are important mediators of this relationship. As discussed in the second chapter, diabetic support is not significantly associated with health decline, but it is strongly associated with adherence to health-promoting activities consisting of a diabetic regimen. Therefore, the extent to which one receives illness support for a given regimen component is highly positively associated with adhering to that component, although this adherence does not necessarily translate into protection against perceived decline in health. As discussed in the fourth chapter, however, different forms of social support interact strongly with health behaviors to prevent functional decline.

As diabetes and other chronic illnesses are increasingly recognized as social and public health priorities, it will become more critical to identify proximal and distal mechanisms by which chronic illness outcomes diverge. No previous studies have adequately addressed this aim as proposed in this research. The identification of divergent pathways (and in particular, the relationship to mechanisms that can be altered in interventions over the life course) promote more effective and efficient interventions.

Chapter 1

Introduction

Research Agenda

My overall research agenda addresses the intersection of social stratification and health and over the life course, particularly as it manifests in differential chronic disease outcomes late in life. More specifically, I am interested in how events throughout the life course (such as cumulative disadvantage, discrimination, and deprivation) as well as events at critical and sensitive periods (such as stressful life events) influence not only earlier health outcomes (intercepts), but also the rate at which health declines (slopes) between and within socio-demographic groups. In addition, I am interested in factors that mediate these relationships. A better understanding of how life course events relate to illness can help identify the mediators between life course events and health outcomes, which can subsequently inform further research and policy.

For this dissertation, I examine longitudinal differences in health and disability disparities of type 2 diabetics by race/ethnicity, socioeconomic status, and by gender. As with some chronic illnesses, type 2 diabetes involves a host of health and lifestyle changes. The ease or difficulty with which one makes a given changes is contingent upon personal, social, and financial resources. I also examine mediating factors relevant to diabetics in particular: regimen adherence, health and illness behaviors, and social ties. The research in this dissertation is addresses only one small piece of health disparities

later in life. However, this dissertation offers several unique contributions.

First, this research examines race, socioeconomic status, and gender with health outcomes of older adults with diabetes longitudinally, using sophisticated methodologies to account for changes in one's behavior over time and health outcomes. These tracking studies include analyses of long-term health outcomes, which take previous observations into consideration and do not assume independence from previous-wave observations as do most longitudinal studies. As much of the research on chronically ill populations uses cross-sectional data, this research provides great insight regarding the disparities that exist beyond prevalence: how different subgroups of the population fare over time.

Second, this dissertation examines the role of key time-varying mediators as processes in the experience of illness and examines to what extent they help or hinder different groups over time. These findings provide contributions to the body of research on regimen adherence, illness-related support, social ties, and physical activity. Finally, this research also incorporated a mixed-methods approach for the final substantive chapter, which has (to my knowledge) never before been used to complement a sophisticated longitudinal examination of health outcomes data. The pairing of these methodologies was challenging. However, it is my hope that the integration of the quantitative analysis (with the ability to track individuals over a decade and to generalize to diabetic populations generally) with the qualitative analysis (with the rich texture provided on the mechanisms related to health) will be further refined and adopted in sociology of health and illness and health services research. There is much potential to gain insight into the processes by which chronically ill populations experience illness. The population to which we generalize is indeed an assembly of individual experiences.

Purpose and Specific Aims

Only recently has empirical research on chronic illness disparities effectively linked life course determinants with health outcomes for older adults. This dissertation is grounded in the intersection of the fields of aging and health disparities. The research analyzes health experiences and decline of older adults with type 2 diabetes mellitus, as well as the influence of social, demographic, and factors that influence these outcomes over time.

Using a life course perspective, this study aims to understand how different characteristics are associated with the experience and outcomes of chronic illness. Specifically, this study examines how social status and support are associated with the maximization of health outcomes among older diabetics. I hypothesize that, even while controlling for regimen adherence and health behavior, individuals from socially disadvantaged backgrounds (non-Whites, those with lower socioeconomic status, and women) and individuals with less social support will independently and disproportionately carry the burden of diabetes—they will report lower health status and more functional limitations relative to their more privileged counterparts. I propose four specific aims to further examine this process:

Specific Aim #1: *To examine the extent through which support is protective against health decline for diabetics*, I (with J. Liang) investigate the extent to which illness-related support promotes regimen adherence and is associated with subsequent prevention of health decline according to different socio-demographic characteristics. I hypothesize support for regimen adherence is negatively associated with self-reported

health decline among older diabetic adults. I also hypothesize that regimen adherence is negatively associated with health decline among older diabetic adults.

Specific Aim #2: *To examine the extent to which there are disparities in the outcomes of diabetes later in life by race/ethnicity*, the long-term outcomes of self-reported health status are estimated over a 14-year period by race/ethnicity: non-Hispanic whites, non-Hispanic African Americans, and Hispanics. I hypothesize that, relative to non-Hispanic whites, both non-Hispanic African Americans and Hispanics experience a more rapid decline of health status over time, controlling for socioeconomic status and health behaviors.

Specific Aim #3: *To examine the extent to which there are disparities in the outcomes of diabetes later in life by socioeconomic status*, I analyze the rate of health decline by different measures of socioeconomic status, including level of education, income, and assets. I hypothesize that those from relatively lower socioeconomic groups experience sharper decline than those from relatively higher socioeconomic groups, controlling for race/ethnicity as well as health behaviors.

Specific Aim #4: *To examine the extent to which there are disparities in the outcomes of diabetes later in life by gender*, I document differences in functional limitations over time for men and women separately, controlling for health and illness behavior / utilization and social tie characteristics. I hypothesize that the rate of decline among both sexes interacts with other social characteristics of interest (social ties and health characteristics).

The strategy for testing the hypotheses and the four specific aims is multi-pronged, using (a) analysis of data from a large, population-based tracking study of non-

institutionalized seniors and (b) analysis of primary data from a small (30) convenience sample in the greater Detroit region. In particular, I examined data from the nine-wave Health and Retirement Study (HRS) and the associated 2003 Diabetes Supplement. Multilevel modeling strategies are used to determine longitudinal change in rates of decline of health and disability status among older adults with diabetes. I also collected health-related, diabetes-specific, and sociodemographic data from a community based sample and conduct in-depth, semi-structured interviews on the respondent's experience of having diabetes mellitus (including relationships with friends and family, outlook and perception of self, and interactions with the health system) and how these experiences have changed over time.

This process elucidates the steepness or rate of decline among diabetes during old age and identifies the diverse pathways along which it unfolds. Central to this research question is how social stratification and support influence chronic illness decline, to link the natural history of diabetes with characteristics such as race, socioeconomic status, and gender. Ultimately, however, the overarching aim of this research is to improve the quality of life and health outcomes of chronically ill populations, particularly those with diabetes.

Theory & Previous Studies

This examination of longitudinal outcomes among older adults (as well as how these vary by life events and social position—by race/ethnicity, socioeconomic status, and gender) is driven by two theoretical frameworks. The Life Course Health and

Development (LCHD) framework and the Health Decision Model (HDM) provide complementary approaches to understand diabetic outcomes and disparities later in life.

The Life Course Health and Development (LCHD) Framework

The key principles of life course theory—an interdisciplinary framework used to guide research and inquiry—include: (a) historical time and place; (b) timing of lives; (c) linked or interdependent lives; and (d) human agency (Elder, 1998). Since the original application of life course theory to studying social structure (Cain, 1964), life course theory has continued to prove a useful and powerful mechanism for capturing and individual, group, and period effects on subsequent health and life circumstances. In the health and illness framework, LCHD theory frames “the varying exposure to health risks experienced by individuals and groups either before or during birth, in childhood, or at various stages in adult life” (Gabe et al., 2004, p. 50). Specifically, it incorporates the four key principles of life course theory to examine health, illness, and aging. The framework examines the role of risk factors, protective factors, and how life experiences influence the health outcomes of individuals throughout their lifespan (Halfon & Hochstein, 2002). Further, the LCHD framework emphasizes the role of critical periods, sensitive stages, and cumulative effects in health, illness, development, and aging.

The LCHD framework has been frequently used to examine the onset and severity of chronic illnesses among individuals and populations. Studies have suggested that there are intergenerational influences on birth weight and cardiovascular risk (Davey Smith et al., 2000), growth in early life and coronary heart disease later in life (Eriksson et al., 2001), and prenatal influences of obesity later in life, an important predictor of chronic

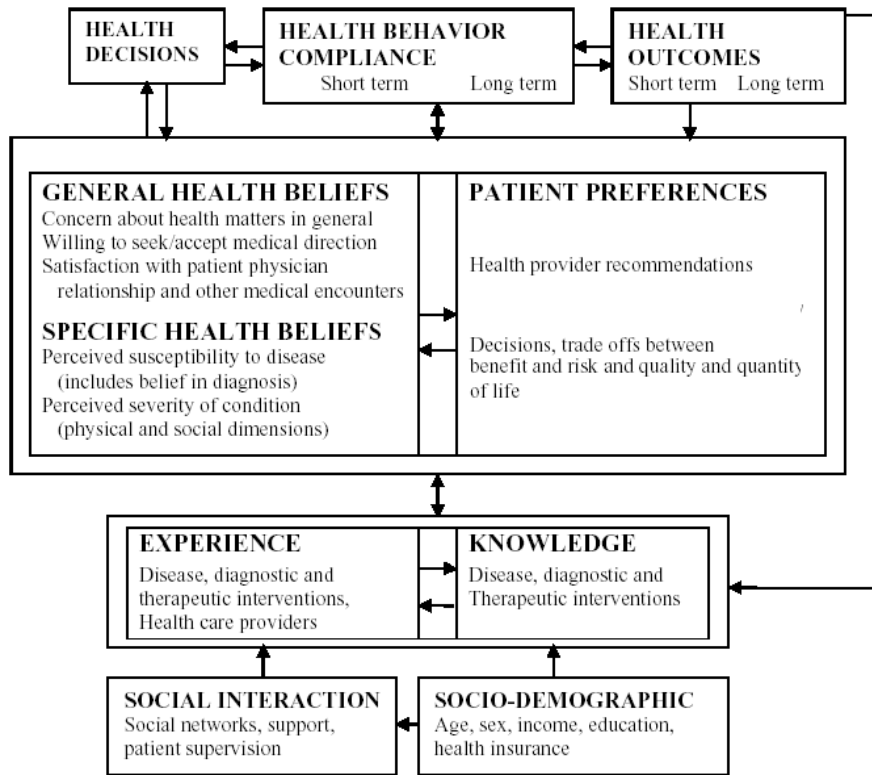
illness (Gillman, 2004). Researchers have also used the LCHD framework to examine the relationship between chronic disease outcomes and social stratification, such as race/ethnicity (Ferraro et al., 1997), socioeconomic status (House et al., 1994; Stroschein, 2005), gender (Zhang & Hayward, 2006), and interactions between them (Kahn & Fazio, 2006; Baltrus et al., 2005). The LCHD framework has primarily been used to explain early-life predictors of the *event* of chronic conditions later in life, such as heart disease, obesity, and diabetes (Forouhi et al., 2004), although a few studies have integrated adult risk factors in the analysis (Lamont et al., 2000). Few studies have incorporated the LCHD framework in the analysis of health over longitudinal tracking studies (House et al., 2005; Liang et al., 2003). These studies incorporating life course theory and the LCHD framework have suggested that chronic illnesses should not be examined in a ‘slice through time’—rather, there are biological, psychological, social, and economic determinants throughout the life course that influence the onset, progression, and experience of chronic illness (Kuh & Ben-Schlomo, 2004). While life course theory is an ideal type and cannot fully be quantified in research, this framework is a useful tool for examining how life circumstances and events—including social stratification by race/ethnicity, socioeconomic status, and gender—influence susceptibility, illness behavior, and disease outcomes.

The Health Decision Model (HDM)

The HDM is used here as a framework to capture proximal and distal health determinants. The HDM, developed by Eraker, Kirscht, and Becker (1984), has been used to examine patient adherence to smoking cessation interventions (Eraker et al.,

1985) and racial differences of health-related beliefs, attitudes, and experiences of cardiac patients (Kressin et al., 2002), and can also be used to frame the analysis of health

Figure 1.1: *The Health Decision Model*



among diabetics. According to this model, health decisions and behavior are shaped by a host of interacting factors, such as sociodemographic characteristics, social interactions, health care experiences and preferences for care, knowledge about disease and other potential treatments, and health beliefs. This model is particularly useful for examining health disparities as its key predictors (health decisions, beliefs, and preferences) have been consistently raised in the literature as an explanation for disparities in chronic illness outcomes. For example, differential (1) rates of compliance by have been found by race/ethnicity (Kaplan et al., 2004), socioeconomic status (Kolbe, 2002), and gender

(Coggins et al., 1998), as have (2) health assessments, beliefs, and attitudes by race/ethnicity (Ferraro et al., 1997); socioeconomic status (Weissfeld et al., 1990), and gender (Hjelm et al., 2002). It is important to note, however, that these findings are not consistent in the literature, and some research has suggested that socially disadvantaged groups (particularly racial/ethnic minorities and lower socioeconomic status individuals) have stronger health-promoting beliefs than do socially advantaged groups (Weissfeld et al., 1990); however, these might not translate into health decisions due to socioeconomic or discriminatory barriers (Escarce et al., 2006; Wilkinson, 1996; van Ryn & Fu, 2003). In conclusion, the HDM suggests several mechanisms through which disparities in health outcomes can vary according to social position (race/ethnicity, socioeconomic status, and gender, and by level of social support). These mechanisms, however, focus on more proximal causes of divergent outcomes, and do not account for the structural, life-course inequalities driving disparities. The HDM therefore complements to the LCHD framework, providing concrete and measurable attributes (consistently suggested in the literature to influence outcomes) as predictors of differential health outcomes over time.

Background & Significance

Diabetes mellitus has transitioned from a disease of the socially privileged to one plaguing disadvantaged populations. Throughout this transition, incidence and prevalence have increased exponentially. Based on data from the National Health Interview Survey (NHIS), the Centers for Disease Control and Prevention (CDC; 2003) reports that the number of Americans with diabetes has increased from 5.8 million to 14.7 million between 1980 and 2004 (exceeding relative growth in the aging population). Among

Americans born in the year 2000, the estimated lifetime risk for diabetes is greater than one in three (Narayan et al., 2003), with a predicted increase in prevalence of 165% in the United States over the next 50 years (Boyle et al., 2001). These risks, however, are not evenly spread throughout the population. The greatest burden of diabetes—in incidence, prevalence, morbidity, and mortality—will continue to be borne by underprivileged groups.

This burden of chronic illness is held by individuals as well as by society. By examining only the aggregate demographic trends and shifts, the individual- and group-level variability of the experiences and outcomes of chronic illness later in life are ignored. This varies greatly between individuals, groups, and over the life span. As argued by House (2002), there is a need to examine the social factors that influence how social disparities shape causes and consequences of illness—linking proximal to distal, “fundamental causes” of illness (Link & Phelan, 1995).

Previous studies have found that disparities are evident in the likelihood of acquiring diabetes, severity following its onset, and the length of life diabetics are able to achieve. These studies—outlined in this background and significance section—draw upon aspects of the theoretical models of interest, the LCHD and HDM frameworks. The bulk of recent research on diabetes outcomes has addressed the improvement of regimen adherence and maximizing effectiveness of self-care and patient-provider relations, which addresses only part of the factors highlighted in the HDM and is divorced from life course factors. While proximal factors are indeed crucial to understanding disparities in diabetes outcomes, the social determinants of diabetes prevalence, morbidity, and mortality patterns warrants further examination, which will be examined in this dissertation.

Race/Ethnicity

Racial or ethnic¹ disparities in health have been suggested as resulting from numerous proximal and distal causes, such as differential health behaviors (Escarce et al., 2006), lower quality of care (Smedley et al., 2003) and discrimination (van Ryn & Fu, 2003). These studies support the hypothesis that non-whites carry a disproportionate burden of diabetes prevalence and experience more rapid decline of health status and mortality after the onset of diabetes.

Diabetes is disproportionately prevalent and severe among Hispanics and African Americans relative to non-Hispanic whites: The CDC (2003) reports that the age-adjusted prevalence of diabetes differs greatly between whites (4.7), Hispanics (6.9), and Blacks (7.4). Among current, population based samples (Mokdad et al., 2001), Blacks are found to have the highest prevalence of diagnosed diabetes, reaching over 11%. However, Narayan et al's (2003) study of NHIS data indicates that Hispanics experience the highest estimated lifetime risk for diabetes, with a risk of 45.4% for males and 52.5% for females. Given higher incidence among several minority groups relative to whites, such disparities are likely to increase in coming decades. The NHIS data further suggest that greater disparities are pervasive in diabetic-related morbidity as well: Hispanics in particular have greater activity limitations and more days of poor health due to diabetes than whites, yet have lower diabetes-related mobility and vision problems, which are not explained by health behavior and regimen adherence (CDC, 2003). Narayan et al's (2003) study, which disaggregated outcomes by race/ethnicity suggests that, as a whole, non-Hispanic whites have fewer Quality-Adjusted Life Years (QALYs) lost and fewer

¹ We conceptualize race and ethnicity using Williams (1996) definition of the "confluence of biological factors and geographic origins, culture, economic, political and legal factors, as well as racism".

Life Years Lost (YYLs) attributable to diabetes than do African Americans and Hispanics, with few exceptions².

Studies concentrating on the health outcomes of a given racial/ethnic group have effectively documented racial/ethnic disparities, independent of factors such as SES. For example Zhang et al. (1988) analyzed Hispanic Health and Nutrition Examination Survey (HANES) data and concluded that Hispanics had significantly higher rates of comorbidities and complications than did non-Hispanic whites. Black et al. (1999) examined data from the Hispanic Established Populations for Epidemiologic Studies of the Elderly, also finding that Hispanics generally experienced comorbidities and declining health outcomes to a greater extent than did whites. To better compare differences *between* (rather than simply within) ethnic/racial groups, researchers have increasingly analyzed diabetes health data from large, population-based longitudinal samples of the elderly, the health implications of diabetes has been studied over time using data sources such as the Health, Aging and Body Composition Study (Figaro et al., 2006), The Health and Retirement Study (Wray et al., 2005), and the Longitudinal Study on Aging (McGuire et al., 2006). While these population-based studies enable comparisons between groups and over time, recent research has not yet mapped racial differences in health outcomes over time due to limited tracking periods and a lack of multiple points of data collection. These studies compared a baseline disability level to that of a follow-up from two to 3.5 years later, which is inadequate to track long-term changes. Furthermore, although race has been found to be significantly associated with

² Hispanic females experienced fewer YLLs attributable to diabetes relative to White females, but in aggregate, these indicators are greater for Hispanics than non-Hispanic Whites.

changes in functionality or morbidity among diabetics³, race was not a central question of inquiry in these studies.

Research provides convincing evidence of racial/ethnic disparities in diabetes onset and outcomes, with four major limitations. First, many studies examine only one minority group, or use a white reference group only. Second, the majority of this literature is cross-sectional. Of the longitudinal research on racial/ethnic disparities, the vast majority lacks the appropriate lag time to adequately address disparities. Finally, several studies have emerged using population-based longitudinal data to document disparities, but race is not centrally examined. Thus, previous studies do not fully capture the mechanisms by which diabetic illness outcomes are influenced over time, proximally and distally, as outlined in the HDM. More research is needed that examines the intersection between diabetic illness outcomes and social disadvantage.

Socioeconomic Status

The relationship between health and SES is an established yet growing field of research. Socioeconomic disadvantage has been linked to health through, for example, relative and absolute disadvantage (Black et al., 1982; Wilkinson, 1996), neighborhood effects (Morenoff, 2003), and access to care (Keeler, 1992). This relationship is particularly salient in the context of diabetes and other chronic illnesses, due to later-in-life divergence of health status by SES (House, et al., 1994) even regardless of mortality effects prior to old age (Hayward et al., 2000). Further, understanding the contribution of socioeconomic differentials at different points in the life course is crucial for

³ Black, et al (1999) found that Blacks and Hispanics experienced less diabetes-related morbidity than whites, but this irregular finding could be attributed to the higher diabetes-mortality rates among minority diabetics at earlier ages.

understanding diabetes disparities because of the high degree to which it can be prevented and controlled (Phelan et al., 2004; Lutfe & Freese, 2005). The influence of SES on diabetes onset is likely multi-dimensional—aspects that might influence the onset and progression of diabetes include parental socioeconomic position, educational achievement, individual or combined family income prior to retirement, pensions, wealth, inequality, or neighborhood deprivation. Most studies examining any combination of these variables find a positive association—even controlling for race and gender—yet we continue to lack clear mechanisms by which these factors relate to the onset or severity of diabetes (Connolly et al., 2000; Hayward, 2000; Robbins et al., 2001).

Recent population-based research has not successfully captured the differential socioeconomic mechanisms associated with diabetes onset, due to the cross-sectional (or short-term) nature of the data collected and the few proxy variables through which socioeconomic status is measured (generally, years of education). In one recent (Mokdad et al., 2001) population-based study, sample participants with less than a high school education had the highest rate of diagnosed diabetes mellitus, nearly 13%. Research addressing the relationship between socioeconomic status and diabetes *outcomes*, however, is more comprehensive. Cross-sectional and longitudinal studies explicitly examining this link have shown socioeconomic disparities in excess mortality (Howard et al., 2000), functional status (Kingston & Smith, 1997), and cognitive functioning (Bent et al., 2000), using measures beyond education: income, wealth, and occupational scale, respectively. Kingston and Smith's (1997) analysis of the impact of education, income and wealth on diabetes prevalence and health outcomes is perhaps the most comprehensive. Using longitudinal data from the HRS, this study found that SES was a

primary predictor of diabetes illness severity. Unfortunately, the several studies recently providing support for the significant relationship between SES and diabetes outcomes that examine longer-term outcomes and multiple observations use SES as a control variable, rather than the outcome variable of interest (Wray et al., 2005; Figaro et al., 2006).

The advantage of directly analyzing the relationships between SES and diabetic outcomes is that the model will be more appropriately specified to include multiple aspects of SES—and will address the potential causal pathways to diabetic outcomes. Of course, such pathways should ideally not be divorced from interlocking forms of social stratification, including SES with age, race/ethnicity, and gender. There is a need for additional research that captures the effects of SES on health that centrally focuses on SES at different life course stages. Such a study, incorporating the LCHD framework and the HDM, will contribute to the health disparities literature a comprehensive and theory-based approach which addresses the multiple pathways by which socioeconomic position affects disease outcomes.

Gender

The mechanisms of gendered diabetes pathway disparities are located in factors such as differing health beliefs, behaviors and social roles/relationships (Arber, 2001). From infancy to the end of life, the courses of disease and illness differ by gender (Forsen et al., 2004; Scheifer et al., 2000; Law et al., 2002; Bello & Mosca, 2004). In addition to biological differences, women and men also differ in how societal roles, expectations, and other upstream factors influence health and access to resources throughout the life

course (Arber, 2001; Williams, 2003; Waldron, 2005). Indeed, previous research has suggested that gender differences in health status are (a) primarily due to differential risks related to roles, stress, lifestyles, and health prevention; (b) secondarily attributable to psychosocial factors (or differential health beliefs and actions based on those beliefs); and (c) biological differences and health care (Verbrugge, 1985). The provision and receipt of social support and informal care is differentially distributed by gender, and can have different implications on health and well-being at different stages in the life course (Moen et al., 1995). Isolating gendered trends on diabetes illness pathways will shed additional light on mechanisms of gender health disparities among older, chronically ill adults.

In the analysis of diabetes and disparities, gender has also been used as a control variable rather than the focus of the study. Worse, illness pathways for women have been analyzed as deviating from the ‘normal’ trajectory of men’s health and illness. Fortunately, compared to SES and race/ethnicity, gender is more easily captured by concise survey questions, enabling greater comparability within and between studies. Gendered differences are easily documented but more challenging to interpret. NHIS data (CDC, 2003) from the last 25 years suggests that there have been gender reversals in age-adjusted diabetes risk: in 1980, diabetes was slightly more prevalent among females (2.9 versus 2.7 percent). In 2004, however, diabetes prevalence rose among the male population, to 5.5 percent (versus 4.7 percent for females), and incidence was slightly higher for men. In a recent study, however, Narayan et al. (2003) report that females have higher lifetime risks of getting diabetes at all ages, with 38.5% for females and 32.8% for males from the 2000 birth cohort. This is exacerbated by earlier onset; in the same study

they estimate that among those diagnosed at 40 years of age, women will lose 14.3 life-years and 22 quality-adjusted life years, compared to 11.6 and 18.6 for men. Among diabetics, women are more likely to engage in most complication-prevention activities and fewer complication inducing activities, but they are disproportionately affected by diabetes, with reduced mobility and greater activity limitations, vision impairments, and more days of poor health (CDC, 2003; Gregg et al., 2000). Certainly, when factors such as age, comorbidities, and life course experiences are taken into account, additional analyses extending beyond gender cross-tabulations are necessary for understanding how gender shapes diabetes incidence and prevalence.

Several analyses from the Women's Health and Aging Study in Baltimore have provided a gendered perspective of comorbidities (Maty et al., 2004; Volpato, 2002), but the exclusive analysis of women precludes analysis of gendered effects. There is great need for additional research, with gender as its focus, to analyze longitudinal health outcomes of men and women from a life course perspective. Such studies should not only identify the way men's and women's pathways diverge, but offer theoretical and statistical support to explain the underlying mechanisms producing disparities, and to tease out the different relative contributions of biological, psychological, and social factors suggested in the HDM, including (a) health beliefs and behaviors and (b) receipt versus provision of social support and informal care.

Opportunities for Longitudinal and Qualitative Research for Diabetic Disparities

With the collection of population-based data (NHANES and NHIS), a body of research is building that addresses differential disease patterns among the chronically ill,

including those with diabetes mellitus. This literature, discussed throughout, has largely confirmed gender, socioeconomic, or racial/ethnic disparities in onset and morbidity patterns among the diabetic population. Given that these cross-sectional panel data do not track individuals over time, however, the complexity and embeddedness of the longitudinal data remain under-examined. Subsequent waves of population-based tracking studies (such as the Health and Retirement Study) provide opportunities for comparative, mixed-models of disparities.

Aging research has increasingly incorporated analyses of health decline. Longitudinal analysis has greatly broadened our understanding of the pathways through which health, illness, disease, and disability diverge later in life. Further, it has enabled the study of illness pathways through LCHD, which is crucial as the timing and duration of life events largely shapes outcomes later in life (Elder, 1985; Hagested, 1990). Examining health decline is particularly useful in aging research given increasing divergence of health status and disability status in later life (Dannefer, 1987; O'Rand, 2001), and has thus contributed to a more comprehensive understanding of the relationships between social factors and health status among the aged (Kelley-Moore & Ferraro, 2004; Jenkins & Rigg, 2004; Kaplan, et al, 1993; Crimmins & Saito, 1993; Liang et al., 2002; Liang et al., 2003). However, this approach has not been adequately applied to examine the influence of social factors in diabetic outcomes, such as the concepts suggested by the HDM. A notable gap in the literature remains for studies answering these questions using longitudinal data on large, diverse, and comparable samples. Further, this research should better tease out the effects of proximal factors (such as comorbidities, health care utilization, and regimen adherence) from the distal

factors of social disparities in health. In fact, only a handful of studies (e.g., Wray et al., 2006) focus on the relationship between social position and diabetes onset and outcomes. With the release of the 2003 HRS Diabetes Supplement data, which provides data on detailed diabetes constructs such as regimen adherence, there is an opportunity to understand these patterns of decline in much greater depth.

Quantitative longitudinal research, however, is also limited in truly disentangling influences on patterns of decline over the life course. Within medical sociology, qualitative sociological studies—in many ways—can provide texture missing in survey-based analyses. Qualitative research offers much promise to better understanding and disaggregating the multiple health determinants among diabetic populations. Numerous qualitative studies have emerged to examine longitudinal determinants and disparities of diabetes. Such studies have specifically addressed the influence of differential health beliefs and coping strategies (Maclean, 1991; Peel et al., 2004; O'Connor et al., 1997; Cravey et al., 2001; Kelleher, 1988; Murphy & Kinmonth, 1995) and patient-provider interactions (Pooley et al., 2001; Peel et al., 2004; Paterson, 2001; Cohen et al., 1994). These qualitative studies therefore discuss numerous important life course factors addressed in the Health Decision Model, employed in this analysis (Eraker, Kirscht, & Becker, 1984). In addition, several qualitative studies of diabetes patterns have specifically addressed the social disparities of question, including race/ethnicity (Greenhalgh, et al., 1998; Samuel-Hodge et al., 2000; Hunt et al., 1998), socioeconomic status (Lutfey & Freese, 2005; Hwang & Bugeja, 2000; van Ryn & Fu, 2003), and gender (Dietrich, 1996). However, with few exceptions (Peel et al., 2004; Paterson, 2001; Cravey et al., 2001), these qualitative studies have focused on regimen adherence or

patient-provider interactions as outcomes. Even fewer qualitative studies (e.g., Paterson et al., 1999) have examined how diabetes significantly and fundamentally reshapes patterns of health over the remainder of the life course. Additional qualitative analyses are needed to gain an improved understanding of diabetes within the context of the greater course of individuals' lives. Ideally, such qualitative research should be extended and triangulated with quantitative data to thoroughly examine patterns health and illness among diabetics.

Previous research supports that diabetes prevalence and complication rates differ, with the greatest disease burden carried by socially disadvantaged groups. Such studies have carefully (yet disparately) documented disparities in diabetes onset and outcomes. However, most of these studies are based on point-in-time estimates. Even fewer studies have been able to illustrate how group patterns differ over time. None have successfully linked health decline with qualitative data as addressed in this dissertation. As diabetes becomes more prevalent in the U.S. population, disadvantaged groups will remain disproportionately affected. Further population-based research is needed to examine how chronic illness is influenced by social stratification in later life. Studies with fundamental causes at their core—such as the analyses in this dissertation—are needed to better examine the complex pathways of disease, disability, and disadvantage. It is in this gap of research that this dissertation research emerges: the analysis and documentation of health decline among the diabetic aged, as well as the influence of social and demographic factors on these patterns.

Design/Methods

Health is shaped throughout the life course by individual characteristics and by the social structure. Therefore, the theoretical framework represents an intersection of two major perspectives in the sociology of health and aging: (a) the heterogeneity in the dynamics of individual aging, and (b) social stratification across the life course. The influences of social stratification on diabetic illness patterns of decline cannot be adequately examined without the incorporation of both perspectives. At the micro level, the research emphasizes individual changes that evolve along various paths, parallel to successful, normal, and pathological aging (Baltes & Baltes, 1990; Rowe & Kahn, 1987). Among type 2 diabetics, determinants include (a) genetic factors and early-life experiences; (b) health behavior prior to diabetes onset; (c) regimen adherence and health behavior following diabetes onset; social interactions including social networks and support; and (d) personal-psychological characteristics such as health beliefs, preferences, experiences, and knowledge (as suggested by the HDM and LCHD). From the macro level, the influence of social stratification by race/ethnicity, SES, and gender are emphasized.

Following the HDM, I hypothesize there are racial/ethnic, SES, and gender differences in diabetes outcomes over time. Specifically, I hypothesize that these disparities persist beyond regimen adherence and other bio-behavioral mechanisms and that social position is fundamental to disparities in health and illness patterns among this aging, chronically ill population. To examine this overarching hypothesis requires the inclusion the additional factors addressed in the model—preferences, social interactions, health experiences, knowledge, and beliefs from a life course perspective.

Data Sources

Health and Retirement Study and Diabetes Supplement

HRS is a national, population-based study that has tracked individuals and households over a sixteen-year period. In 1992, approximately 12,654 community-dwelling individuals born from 1931-1941 participated in the study, with a response rate (rr) of 81.7%. Adjusting for mortality, the response rates have remained above 84% in the seven subsequent waves. The HRS sample and study has been merged with the Assets and Health Dynamics of the Oldest Old (AHEAD) data. Further, with the incorporation of respondent spouses and replacement cohorts, the combined dataset now includes comprehensive data from over 21,000 living Americans and over 30,000 cases who have participated in at least one wave.

The HRS 2003 Supplement is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and was conducted by the University of Michigan (Survey Research Center). The 2003 Diabetes Supplement was mailed to the 2,381 cases reporting a diagnosis of diabetes in the 2002 HRS and who were eligible for the supplemental examination. Questionnaires were returned by 1,901 respondents (rr 79.8%). This supplement extensively addresses concerns specific to diabetic populations, including adherence (each regimen component), social support (in general and for adherence to specific regimen components), utilization of services, health care experiences, knowledge about disease and other potential treatments, health beliefs, and satisfaction with care. In sum, the Diabetes Supplement is able to capture—to some

extent—each of the variables addressed in the Health Decision Model, many of which are used as covariates and control variables in the series of analyses proposed⁴.

The Institute of Gerontology Pool

The Research Participant Program at the Geriatrics Center links individuals to research studies. This pool includes approximately 1,400 community-dwelling seniors in the greater Ann Arbor, Michigan area. This convenience sample over-represents older Americans who are female, white, affluent, and from highly educated backgrounds, which limits the ability to examine racial/ethnic, socioeconomic, and gender disparities in diabetes outcomes. Further, the pool over-represents individuals who have not been institutionalized and maintain good cognitive health. To address the problem of sampling bias, the sample was stratified to over-represent individuals from economically disadvantaged backgrounds and have a racially/ethnically diverse sample. This is possible as the Institute of Gerontology maintains sociodemographic and health information, which enables the opportunity of a stratified sample to be contacted for an interview. Further, it makes the comparison possible of sociodemographic and health characteristics between those who do and do not choose to participate in the study. The data collection took place from March to June 2008.

In-Depth Interviews

Using event prompts, all respondents were to engage in an in-depth interview on their experiences with—and challenges stemming from—diabetes. The qualitative component of the research design elucidated, from a patient perspective, the determinants

⁴ This procedure was recently pursued by Gallo et al (2004) to examine job loss as a risk factor for myocardial infarction and stroke using HRS data.

and specific challenges of diabetes care, including regimen adherence and health care interactions which were largely missed from the survey component of the design. The interviews therefore provided further data to support to the hypotheses. When the quantitative analyses did not offer support to the hypotheses, the qualitative data provided additional insight on the relationship between stratification and diabetes illness pathways.

The mixed-methods approach is an effective tool for better understanding of diabetes determinants and pathways throughout the life course; however, generalizations are limited by the small size of the convenience sample. The triangulation of this convenience sample with HRS provides several advantages: the themes emerging through the in-depth interviews provide a fuller and more textured analysis of experiences, while the quantitative results can be compared results from a nationally-representative sample.

Methodological Procedures

Procedure 1: Multilevel Modeling

Hierarchical linear modeling is used to estimate the parameters associated with health decline over time (Raudenbush & Bryk, 2002; Rabe-Hesketh & Skrondal, 2005).

Specifically, individual health decline is modeled as: $Y_{iA} = \pi_{0i} + \pi_{1i}A + \varepsilon_{iA}$

where Y_{iA} is self-rated health / functional limitations for individual i at age A (at a given survey); π_{0i} is the intercept of self-rated health/limitations/adherence for individual i ; π_{1i} is the rate of change (slope) in self-rated health/functional limitations for individual i across age; and ε_{iA} is the random error in self-rated health/functional limitations for individual i at age A . An important feature of this equation is the assumption that the intercept and growth parameters vary across individuals, so they become dependent

variables in the level 2 (or person-level) model, where individual and/or group characteristics are included as predictors. The second-level model is represented as the following for individual growth parameters:

$$\pi_{pi} = \beta_{p0} + \sum \beta_{pq} X_{qi} + r_{pi}$$

Here X_{qi} is a covariate (such as race/ethnicity, SES, and gender) associated with individual i and β_{pq} represents the effect of X_{qi} on the growth parameter (π_{pi}). r_{pi} is a random effect with a mean of 0. For the sample as a whole, both linear and nonlinear change is evaluated by estimating with the first equation while nonlinear change is tested separately through the data by adding one or more appropriate polynomial terms. These changes are, in turn, the dependent variable in a multinomial logistic analysis to determine the effects of baseline covariates. This approach is particularly useful for analyzing diabetes over time, as it enables an assessment of the “shape”, or rate of change. This strategy has been used to capture functional limitation, self-assessed, and mortality health trajectories by Liang and colleagues (2002, 2003).

The proposed study has several limitations. First, this research relies primarily on self-reported data. The global categorical measure (self-rated health on a 1-5 scale) has been found to be highly concordant with clinical assessments, as well as a reliable predictor of mortality and health care utilization (Idler & Benyamini, 1997). However, the heavy reliance on self-reported data limits the external validity of the findings of this research. To address this concern the measurements include validated scales when possible and appropriate. Second, health is a multi-faceted and complex state, not limited to self-reported health status and functional ability. Finally, the HRS sample provides

individual prospective tracking data beginning in middle age or older adulthood, limiting the ability to analyze—and make generalizations to—a full life-course model.

Procedure 2: Qualitative Data Analysis and Triangulation of Qualitative Data

As discussed in Chapter 4, the qualitative interviews were transcribed by undergraduate research assistants and were independently coded according to the HDM framework (with a few adaptations as appropriate). The entire passages were independently coded than the two coders met to reach a consensus. The coded passages were thereafter entered into NVivo. Coders did not participate as interviewers in the same interviews they coded. Coders were also reminded to code a phenomenon regardless of whether it was absent or present. These relevant coded passages were viewed following the quantitative data analysis and passages were coded that supported findings, refuted findings, or offered additional information or mechanisms not shown in the quantitative findings. Excerpts and summaries of quantitative findings were generated through this process.

Finally, in-depth survey interviews were coded and analyzed using the Explanatory Design, which is a two-phase mixed methods design with the objective of using qualitative data to explain or build upon quantitative results (Creswell et al., 2003; Creswell & Clark, 2007). This method is appropriate for providing explanations or mechanisms for otherwise surprising or opaque quantitative results (Morse, 1991).

Conclusions and Chapter Outline

This proposed research strategy enabled the examination of the four specific aims—including the investigation of patterns of health decline later in life and the identification of the diverse pathways along which it unfolds. Through the multi-tiered

methodology, I propose a comprehensive and nuanced examination of how social position and stratification influence the pattern of chronic illness decline, to link the natural history of diabetes with characteristics such as social support, race, socioeconomic status, and gender. The analyses are in an area in critical need of additional research. This research is well-positioned to inform gerontological health policy and practice.

The second chapter of this dissertation (*Diabetes-Related Support, Regimen Adherence and Health Decline among Older Adults*) examines the association between regimen adherence and regimen support for older adults with diabetes as well as the relationship between regimen-related support and health decline over a two-year period. The third chapter (*Health Decline in Older Adults with Diabetes: Are Race/Ethnicity and Socioeconomic Status Independent Predictors of Long-term Outcomes?*) analyzes whether socioeconomic status and race-ethnicity are both long-term predictors of health status among older adults. The fourth chapter (*Gender, Health Behaviors, and the Paradox of Social Ties: A Mixed-Method Examination of Functional Decline among Mid- and Late-Life Diabetics*) investigates gender differences in functional decline and the mediators of health and illness behavior and social ties. This dissertation concludes with implications for research and policy as well as the next steps proposed in my research agenda.

References

- Arber, S. (2001). "Gender and physical health." In N.J. Smelser and P.B. Baltes. (eds.). *International Encyclopedia of the Social and Behavioral Sciences*, 9:5960-5965.
- Baltes, P. B., & Baltes, M. M. (1990). "Psychological perspectives on successful aging: The model of selective optimization with compensation." In P.B. Baltes & M. M. Baltes (Eds.), *Successful Aging*, (pp. 1-34). Cambridge, England: Cambridge University Press.
- Baltrus, P. T., Lynch, J. W., Everson-Rose, S., et al. (2005). "Race/ethnicity, life-course socioeconomic position, and body weight trajectories over 34 years: The alameda county study." *American Journal of Public Health*, 95(9), 1595-1601.
- Bello N, & Mosca L. (2004). "Epidemiology of coronary heart disease in women." *Progress in Cardiovascular Diseases*, 46(4):287-295.
- Ben-Schlomo, Y., & Kuh, D. (2002). "A Life Course Approach to Chronic Disease Epidemiology: Conceptual Models, Empirical Challenges and Interdisciplinary Perspectives." *International Journal of Epidemiology*, 31, 285-93.
- Bent, N., Rabbitt, P., & Metcalfe, D. (2000). "Diabetes mellitus and the rate of cognitive ageing." *British Journal of Clinical Psychology*, 39(4), 349-362.
- Black, D., Morris, J. N., Smith, C., & Townsend, P. (1982). *Inequalities in health: The Black report*. London: Department of Health and Social Security.
- Black, S. A., Jakobi, P. L., Rush, R. D., et al (1999). "Ethnic variation in the health burden of self-reported diabetes in adults aged 75 and older." *Ethnic Disparities*, 9(1):22-32.
- Black, S. A., Ray, L. A., & Markides, K. S. (1999). "The prevalence and health burden of self-reported diabetes in older Hispanic established populations for epidemiologic studies of the elderly." *American Journal of Public Health*, 89(4), 546-552.
- Boyle, J. P., Honeycutt, A. A., Narayan, K. M., Hoerger, T. J., Geiss, L. S., Chen, H., et al. (2001). "Projection of diabetes burden through 2050: Impact of changing demography and disease prevalence in the U.S." *Diabetes Care*, 24, 1936-40.
- Cain, L. (1964). "Life course and social structure." In Robert E. L. Faris *Handbook of Modern Sociology*, Chicago: Rand McNally, 272-309.
- Centers for Disease Control and Prevention (2003). "Diabetes Surveillance System." Atlanta, GA: U.S. Department of Health and Human Services. Accessed at <http://www.cdc.gov/diabetes/statistics/index.htm> on 28 October 2006
- Coggins, C., Lewis, J., Caggiula, A., et al. (1998). "Differences between women and men with chronic renal disease." *Nephrology Dialysis Transplantation*, 13(6), 1430-1437.

- Cohen, M. Z., Tripp-Reimer, T., Smith, C., Sorofman, B., & Lively, S. (1994). "Explanatory models of diabetes: Patient practitioner variation." *Social Science & Medicine*, 381, 59-66.
- Connolly, V., Unwin, N., Sheriff, P., Bilous, R., & Kelly, W. (2000). "Diabetes prevalence and socioeconomic status: A population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas." *Journal of Epidemiology and Community Health*, 54, 173-177.
- Cox, D. R. (1972). "Regression models and life-tables" (with discussion). *JR Stat Soc; B34*:187-220.
- Cravey, A. J., Washburn, S. A., Gesler, W. M., Arcury, T. A., & Skelly, A. H. (2001). "Developing socio-spatial knowledge networks: A qualitative methodology for chronic disease prevention." *Social Science & Medicine*, 52(12), 1763-75.
- Creswell, J. W., & Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.
- Creswell, J. W., Clark, V. L., Gutmann, M., & Hanson, W. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage.
- Crimmins, E. M., & Saito, Y. (1993). "Getting better and getting worse: Transitions in functional status among older Americans." *Journal of Aging and Health*, 5(1), 3-36.
- Dannefer, D. (1987). "Aging as intra-cohort differentiation: Accentuation, the Matthew effect, and the life course." *Sociological Forum*, 2, 211-236.
- Davey Smith, G., Harding, S., & Rosato, M. (2000). Relation between infants' birthweight and mothers' mortality: Prospective observational study. *BMJ*, 320, 839-840.
- Dietrich, U. C. (1996). "Factors influencing the attitudes held by women with type II diabetes: A qualitative study." *Patient Education and Counseling*, 29(1), 13-23.
- Elder, G. H. (1985). "Perspectives on the life course." In G. H. Elder (Ed.), *Life course dynamics* (pp. 23-49). Ithaca, NY: Cornell University Press.
- Elder, G. H. (1998). "The life course as development theory." *Child Development*, 69(1), 1-12.
- Eraker, S. A., Becker, M. H., Strecher, V. J., and Kirscht, J. P. (1985). "Smoking behavior, cessation techniques, and the Health Decision Model." *The American Journal of Medicine*, 78, 817-825.
- Eraker, S. A., Kirscht, J. P., Becker, M. H. (1984). "Understanding and improving patient compliance." *Annals of Internal Medicine*, 100(2), 258-68.

- Eriksson, J. G., Forsen, T., Tuomilehto, J., et al. (2001). "Early growth and coronary heart disease in later life: Longitudinal study." *BMJ*, 322, 949-953.
- Escarce, J. J., Morales, L. S., & Rumbaut, R. G. (2006). "The health status and health behaviors of Hispanics." In M. Tienda & F. Mitchell (Eds.) *Hispanics and the Future of America*. Washington, DC: The National Academies Press. Pp. 362-409.
- Ferraro, K. F., Farmer, M. M., & Wybraniec, J. A. (1997). "Health trajectories: Long-term dynamics among Black and White adults. *Journal of Health and Social Behavior*, 38, 38-54.
- Figaro, M. K., Kritchevsky, S. B., Resnick, H. E., et al (2006). "Diabetes, inflammation, and functional decline in older adults: Findings from the Health, Aging and Body Composition (ABC) study." *Diabetes Care* 29, 2039-45.
- Forouhi, N., Hall, E., & McKeigue, P. (2004). "A life course approach to diabetes." In D.L. Kuh & Y. Ben-Shlomo (2nd ed.) *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life*. Oxford: Oxford University Press, 165-188.
- Forsen, T., Osmond, C., Eriksson, J. G., & Barker, D. J. (2004). "Growth of girls who later develop coronary heart disease." *Heart*, 90(1), 20-24.
- Gabe, J., Bury, M., & Elston, M. A., eds. (2004). *Key Concepts in Medical Sociology*. London: Sage Publications.
- Gallo, W. T., Bradley, E. H., Falba, T. A., et al (2004). "Involuntary job loss as a risk factor for subsequent myocardial infarction and stroke: Findings from The Health and Retirement Study." *American Journal of Industrial Medicine*, 45(5), 408-416.
- Gillman, M. W. (2004). "A life course approach to obesity." In D.L. Kuh & Y. Ben-Shlomo (2nd ed.) *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life*. Oxford: Oxford University Press, 189-217.
- Greenhalgh, T., Helman, C., & Chowdhury, M. (1998). "Health beliefs and folk models of diabetes in British Bangladeshis: A qualitative study." *BMJ*, 316, 978-983.
- Gregg, E. W., Beckles, G. L., Williamson, D. F. (2000). "Diabetes and physical disability among older U.S. adults." *Diabetes Care*, 23(9), 1272-1277.
- Hagested, G. O. (1990). "Social perspectives on the life course." In R. H. Binstock & L. K. George (Eds.), *Handbook of Aging and Social Sciences* (3rd ed., pp. 151-168). New York: Academic Press.
- Halfon, N., & Hochstein, M. (2002). "Life course health development: An integrated framework for developing health, policy, and research." *Milbank Quarterly*, 80, 433.

- Hayward, M. D., Miles, T. P., Crimmins, E. M., & Yang, Y. (2000). The significance of socioeconomic status in explaining the racial gap in chronic health conditions. *American Sociological Review*, *55*(6), 910-930.
- Hjelm, K., Nyberg, P., & Apelqvist, J. (2002). "Gender influences beliefs about health and illness in diabetic subjects with severe foot lesions." *Journal of Advanced Nursing*, *40*(6), 673.
- House, J. S. (2002). "Understanding social factors and inequalities in health: 20th century progress and 21st century prospects." *Journal of Health and Social Behavior*, *43*, 125-142.
- House, J. S., Lantz, P. M., & Herd, P. (2005). "Continuity and change in the social stratification of aging and health over the life course: Evidence from a nationally representative longitudinal study from 1986 to 2001/2002 (Americans' Changing Lives Study)." *Psychological Sciences and Social Sciences*, *60*, S15-S26.
- House, J. S., Lepkowski, J. M., Kineey, A. M., Mero, R. P., Kessler, R. C., & Herzog, R. A. (1994). "The social stratification of aging and health." *Journal of Health and Social Behavior*, *35*, 213-34.
- Howard, G., Anderson, R. T., Russell, G., Howard, V. J., & Burke, G. L. (2000). "Race, socioeconomic status, and cause-specific mortality." *Annals of Epidemiology*, *10*(4), 214-23.
- Hunt, L. M., Valenzuela, M. A., & Pugh, J. (1998). "Porque me toco a mi? Mexican American diabetes patients' causal stories and their relationship to treatment behaviors." *Social Science & Medicine*, *46*(8), 959-69.
- Hwang, S. W., & Bugeja, A. L. (2000). "Barriers to appropriate diabetes management among homeless people in Toronto." *CMAJ*, *163*(2).
- Idler, E. L., & Benyamini, Y. (1997). "Self-rated health and mortality: A review of twenty-seven community studies." *Journal of Health and Social Behavior*, *38*(1), 21-37.
- Jenkins, S. P., & Rigg, J. A. (2004). "Disability and disadvantage: Selection, onset, and duration effects." *Journal of Social Policy*, *33*, 479-501.
- Kahn, J., & Fazio, E. M. (2006). "Economic status over the life course and racial disparities in health." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *60*, S76-S84.
- Kaplan, G. A., Strawbridge, W. J., Camacho, T., & Cohen, R. D. (1993). "Factors associated with change in physical functioning in the elderly: A six-year prospective study." *Journal of Aging and Health*, *5*(1), 140-153.
- Kaplan, R. C., Bhalodkar, N. C., Brown, E. J., et al. (2004). "Race, ethnicity, and sociocultural characteristics predict noncompliance with lipid-lowering medications." *Preventive Medicine*, *39*(6), 1249-1255.

- Keeler, E. B. (1992). "Effects of cost sharing on use of medical services and health." *Journal of Medical Practice Management*, 8, 317-321.
- Kelleher, D. (1988). "Coming to terms with diabetes: Coping strategies and non-compliance." In R. Anderson, & M. Bury (Eds.), *Living with Chronic Illness*. London: Unwin Hyman.
- Kelley-Moore, J. A., & Ferraro, K. F. (2004). "The Black/White disability gap: Persistent inequality later in life?" *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 59: S34-S43.
- Kingston, R. S., & Smith, J. P. (1997). "Socioeconomic status and racial and ethnic differences in functional status associated with chronic diseases." *American Journal of Public Health*, 87(5), 805-810.
- Kolbe, J. (2002). "The influence of socioeconomic and psychological factors on patient adherence to self-management strategies: Lessons learned in asthma." *Disease Management & Health Outcomes*, 10(9), 551-570.
- Kressin, N. R., Clark, J. A., Whittle, J., et al. (2002). "Racial differences in health-related beliefs, attitudes, and experiences of VA cardiac patients: Scale development and application." *Medical Care*, 41(1), Supplement, I-72-I85.
- Kuh D. L., & Ben-Shlomo, Y. (2004). *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life*. (2nd ed.) Oxford: Oxford University Press.
- Kuh, D., & Hardy, R., Eds. (2002). *A Life Course Approach to Women's Health*. Oxford: Oxford University Press.
- Lamont, D., Parker, L., White, M. et al. (2000). "Risk of cardiovascular disease measured by carotid intima-media thickness at age 49–51: Lifecourse Study." *BMJ*, 320, 273–78.
- Law, C. M., Shiell, A. W., Newsome, C. A., et al. (2002). "Fetal, infant, and childhood growth and adult blood pressure: A longitudinal study from birth to 22 years of age." *Circulation*, 105(9), 1088-92.
- Liang, J., Bennett, J. M., Sugisawa, H., Kobayashi, E., & Fukaya, T. (2003). "Gender differences in old age mortality: Roles of health behavior and baseline health status." *Journal of Clinical Epidemiology*, 56(6), 572-82.
- Liang, J., Bennett, J., Krause, N., Kobayashi, E., Kim, H., Brown, J. W., et al. (2002). "Old age mortality in Japan: Does the socioeconomic gradient interact with gender and age?" *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57: S294-S307.
- Liang, J., Shaw, B. A., Krause, N. M., et al. (2003). "Changes in functional status among older adults in Japan: Successful and usual aging." *Psychology & Aging*, 18(4), 684-95.

- Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease." *Journal of Health and Social Behavior*, 35 (extra issue), 80-94.
- Lutfey, K., & Freese, J. (2005). –Toward some fundamentals of fundamental causality: Socioeconomic status and health in the routine vlinic visit for diabetes." *The American Journal of Sociology*, 110(5), 1326-47.
- Maclean, H. (1991). "Patterns of diet related self-care in diabetes." *Social Science & Medicine*, 32(6), 689-696.
- Maty, S. C., Fried, L. P., Volpato, S., et al (2004). "Patterns of disability related to diabetes mellitus in older women." *Journals of Grontology Series A: Biological Sciences and Medical Sciences*, 59(2), 148-153.
- McGuire, L. C., Ford, E. S., & Ajani, U. A. (2006). "The impact of cognitive functioning on mortality and the development of functional disability in older Americans with diabetes: The second longitudinal study on aging." *BMC Geriatrics* 1, 6-8.
- Moen, P., Robison, J., & Dempster-McLain, D. (1995). –Caregiving and women’s well-being: A life course approach. *Journal of Health and Social Behavior*, 36(3), 259-273.
- Mokdad, A. H., Bowman, B. A., Ford, E. S., Vinicor, F. V., Marks, J. S., & Koplan, J. P. (2001). –The continuing epidemics of obesity and diabetes in the United States." *JAMA*, 286, 1195-1200.
- Morenoff, J. D. (2003). "Neighborhood mechanisms and the spatial dynamics of birth weight." *American Journal of Sociology*, 108(5), 976-1017.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*, 40, 120-123.
- Murphy, E., & Kinmouth, A. L. (1995). "No symptoms, no problem? Patients’ understandings of non-insulin dependent diabetes." *Family Practice*, 12(2), 184-192.
- Narayan, K. M., Boyle, J. P., Thompson, T. J., Sorenson, S. W., & Williamson, D. F. (2003). " Lifetime risk for diabetes mellitus in the United States." *JAMA*, 290, 1884-1890.
- O’Rand, A. M. (2001). "Stratification and the life course: The forms of life course capital and their interrelationships." In R. H. Binstock & L. K. George (Eds.), *Handbook of Aging and the Social Sciences* (5th ed., pp. 197-213). San Diego, CA: Academic Press.
- Paterson, B. (2001). –Myth of empowerment in chronic illness." *Journal of Advanced Nursing*, 34(5), 574-581.
- Paterson, B., Thorne, S., Crawford, J., & Tarko, M. (1999). –Living with diabetes as a transformational experience." *Qualitative Health Research*, 9(6), 786-802.

- Peel, E., Parry, O., Douglas, M., & Lawton, J. (2004). "Blood glucose self-monitoring in non-insulin-treated type 2 diabetes: A qualitative study of patients' perspectives." *British Journal of General Practice*, 54, 183-188.
- Phelan, J. C., Link, B. G., Diez-Roux, A., Kawachi, I., & Levin, B. (2004). "Fundamental causes of social inequalities in mortality: A test of the theory." *Journal of Health and Social Behavior*, 45(3), 265-285.
- Pooley, C. G., Gerrard, C., Hollis, S., Morton, S., & Astbury, J. (2001). "Oh it's a wonderful practice...you can talk to them': A qualitative study of patients' and health professionals' views on the management of type 2 diabetes." *Health & Social Care in the Community*, 9(5), 318-326.
- Rabe-Hesketh, S., & Skrondal, A. (2005). *Multilevel and Longitudinal modeling using Stata*. College Station, TX: Stata Press.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and data analysis methods* (2nd Edition). Thousand Oaks, CA: Sage.
- Robbins, J. M., Vaccarino, V., Zhang, H., & Kasl, S. V. (2001). "Socioeconomic status and type 2 diabetes in African American and non-Hispanic white women and men: Evidence from the Third National Health and Nutrition Examination Survey." *American Journal of Public Health*, 91(1), 76-83.
- Rowe, J. W., & Kahn, R. (1987). "Human aging: Usual and successful." *Science*, 237, 143-149.
- Samuel-Hodge, C. D., Headen, S. W., Skelly, A. H., et al. (2000). "Influences on day-to-day self-management of type 2 diabetes among African-American women: Spirituality, the multi-caregiver role, and other social context factors." *Diabetes Care*, 23(7), 928-33.
- Scheifer, S. E., Escasce, J. J., & Schulman, K. A. (2000). "Race and sex differences in the management of coronary artery disease." *American Heart Journal*, 139(5), 848-857.
- Smedley, B. D., Stith, A. Y., & Nelson, A. R., Eds. (2003). *Unequal treatment: Confronting racial and ethnic disparities in Health Care*. Washington, DC: National Academies Press.
- Strohschein, L. (2005). "Household income histories and child mental health trajectories." *Journal of Health and Social Behavior*, 46(4), 359.
- Therneau, T., & Grambsch, P. (2000). *Modeling Survival Data: Extending the Cox Model*. New York: Springer.
- Van Ryn, M., & Fu, S. S. (2003). "Paved with good intentions: Do public health and human service providers contribute to Racial/Ethnic disparities in health?" *American Journal of Public Health*, 93(2), 248-255.

- Verbrugge, L. M. (1985). "Gender and health: An update on hypotheses and evidence." *Journal of Health and Social Behavior*, 26(2), 156-182.
- Volpato, S., Blaum, C., Resnick, H., et al (2002). "Comorbidities and impairments explaining the association between diabetes and lower extremity disability: The Women's Health and Aging Study." *Diabetes Care*, 25(4), 678-683.
- Waldron, I. (2005). "Gender differences in mortality—causes and variation in different societies." *The Sociology of Health & Illness: Critical Perspectives*. P. Conrad (Ed.). New York: Worth, pp. 38-54.
- Weissfeld, J. L., Kirscht, J. P., & Brock, B. M. (1990). "Health beliefs in a population: The Michigan Blood Pressure Survey." *Health Education & Behavior*, 17(2), 141-155.
- Wilkinson, R. G. (1996). *Unhealthy societies: The afflictions of inequality*. New York: Routledge.
- Williams, D. R. (1996). "Race/Ethnicity and socioeconomic status: Measurement and methodological issues." *International Journal of Health Services*, 26, 483-505.
- Williams, D. R. (2003). "The health of men: Structured inequalities and opportunities." *American Journal of Public Health*, 93(4), 724-730.
- Wray, L. A., Alwin, F. F., McCammon, R. J., Manning, T., & Best, L. E. (2006). "Social status, risky health behaviors, and diabetes in middle-aged and older adults." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 61: S290-S298.
- Wray, L., Ofstedal, M., Langa, K., & Blaum, C. (2005) "The effect of diabetes on disability in middle aged-and older adults." *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 60, 1206-1211.
- Zhang, J., Markides, K. S., Lee, D. J. (1988). "Health status of diabetic Mexican Americans: Results from the Hispanic HANES." *Ethnic Disparities*, 1, 273-279.
- Zhang, Z., & Hayward, M. D. (2006). "Gender, the marital life course, and cardiovascular disease in late midlife." *Journal of Marriage and the Family*, 68(3), 639-657.

Chapter 2

Diabetes-Related Support, Regimen Adherence and Health Decline among Older Adults

(This chapter was published in the *Journal of Gerontology* with Professor Jersey Liang)

Abstract

Social support is generally found to be health-promoting; however, there is little consensus regarding the mechanisms. Illness support has been proposed to promote regimen adherence and subsequent prevention of health decline. We hypothesize that (a) support for regimen adherence is negatively associated with self-reported health decline among and that (b) regimen adherence is negatively associated with health decline among older diabetic adults. We used Health and Retirement Study (HRS) data on individuals over the age of 60 with type 2 diabetes (n=1788), examining change in self-reported health status over a 2-year period using binomial and cumulative ordinal logistic regression models. Diabetic support is not significantly associated with health decline, but it is strongly associated with adherence to the diabetic regimen. Therefore, the extent to which one receives illness support for a given regimen component is highly positively associated with adhering, although this adherence does not necessarily translate into protection against perceived decline in health. Illness-related support appears to be a mechanism through which support matters in the diabetic population. Although this relationship did not extend to prevention of health status decline among diabetics, the relationship between support and illness management is promising.

Introduction

Sociological research has consistently emphasized the vulnerability associated with social isolation and the benefits arising from social integration (Durkheim, 1897; Kohn and Clausen, 1955). However, the field has encountered more difficulty in quantifying and generalizing this relationship due to endogeneity concerns, as the majority of studies are based on cross-sectional data. The last several decades of social epidemiological research on relationships has utilized regional prospective samples, enabling a more confident conclusion that the association is, at least in part, causally-determined (Berkman and Syme 1979; House, Landis and Umberson 1988; Schoenbach et al. 1986; Schulz et al., 2006; Uchino 2004; Wills and Filer 2001). Further, great strides have been made in the conceptualization and measurement of social support and social networks in relation to the behavioral, health, and social sciences (Ajrouch, Antonucci and Janevic 2001; Cohen and Gottlieb 2000; Sarason, Sarason and Gurung 2001). However, these relationships vary in significance by age, gender, race/ethnicity, and socioeconomic status (Bae et al. 2001; Blazer 1982; Everard, Lach, Fisher and Baum 2000; House, Robbins and Metzner 1982; House et al. 1988; Kaplan et al. 1988; Schoenbach et al. 1986; Seeman et al. 1987). Despite the emerging empirical evidence supporting the connection between health and social relationships, there is little theoretical or empirical consensus regarding the mechanisms.

Social Support and Diabetes

In the examination of aging, chronically ill populations, the relationship between social support and health status has also been debated in the literature. Previous studies generally suggest that social support is positively associated with health status, but

research has long lacked consensus on the mechanisms through which this relationship operates (Kaplan, Cassel and Gore 1977). Numerous mechanisms and mediators have been suggested in the literature (Kaplan 1989), some of which include the promotion of self-esteem and control through relationships (Krause and Borawski-Clark 1994), the receipt of informal care (Langa et al. 2002), and illness self-management (Gallant 2003). This literature suggests that, as the population ages, it is necessary to move beyond the individual to understand how health outcomes can be improved (Gore 1989); however, a better understanding of the attributes of social support that contribute to the optimization of health outcomes among the chronically ill is yet to be attained (Gallant 2003).

Older adults with type 2 diabetes mellitus are an ideal group to extend the analysis of this relationship. Diabetes mellitus is extremely costly, involving high direct medical costs (estimated \$44 billion per year in 1997 dollars) and indirect costs (estimated \$54 billion per year), such as lost productivity (American Diabetes Association 1998). In addition, the indirect cost of informal care for diabetics has been estimated between \$3 and \$6 billion per year (Langa et al. 2002). Further, older adults with diabetes mellitus of intermediate functioning have, in particular, been found to have a sharper general decline than non-diabetics (Blaum et al. 2003). As the proportion of Americans with diabetes grows and the population ages, it is crucial that more is known about the successful treatment of this illness. Due to the complex and rigorous regimen required for successful maintenance, diabetes mellitus has been referred to as an “exemplar” for the need to better understand the correlates of successful self-management (Hill-Briggs 2003). The high cost, high incidence and prevalence, and complex regimen related to diabetes highlight the importance for understanding how support can improve adherence. The

extent to which social support is protective for regimen adherence—and overall health—among diabetics therefore has important implications for policy and practice.

Research on the effects of social support on health status among diabetics and other chronically ill populations centers around enhancement of commitment to self-care or regimen adherence (Belgrave and Lewis 1994; Ruggerio et al. 1990; Peyrot, McMurry, and Hedges 1987). In a comprehensive meta-analysis of studies addressing the relationship between social support and chronic illness self-management, Gallant (2003:170) finds that despite evidence for a “modest” positive relationship, especially among diabetics, few studies have addressed this relationship adequately, with the majority focusing on cross-sectional, relatively young, and ethnically homogenous samples. Despite previous efforts, the relationship between social support, regimen adherence, and overall health is yet to be thoroughly examined. Given the limitations of the previous studies, several factors remain ambiguous. Most are cross-sectional and lack a strong theoretical base, and are thus limited in their ability to assert the direction of causality. Further, previous studies examine vastly different notions of social support (family cohesion, community involvement, social ties, etc).

Previous research has suggested that adherence to a diabetic regimen is protective against health decline through such pathways as glycemic control and obtaining standardized tests and therapies. Through improved adherence, therefore, studies have shown that an individual will report improved outcomes not only because one’s health *is better*, but largely because it is *perceived* to be better as well (Heisler, Smith, Hayward, Krein, and Kerr 2003). Despite such findings, however, the borders between self-perceived health status, changes in health status, and regimen adherence continue to be

undefined, largely due to the cross-sectional nature of most studies. Further, research is needed that investigates the role regimen adherence might take as a mediator through which either examined the relationship between social support and regimen adherence or the relationship between social support and health status, but not both. Therefore, such studies were not able to determine whether health benefits related to social support is largely a consequence of improved adherence. Additional research is needed that longitudinally examines the relationship between social support and health status, as well as how it relates to regimen adherence. Ideally, this research should provide insight into the mechanisms by which social support contributes to health.

Focusing on diabetic older adults, this research attempts to clarify this concern by addressing the following questions: (1) What is the association between illness-related support (in contrast to competing forms of social relationships) and health decline among this population? (2) What is the relationship between illness-related support and regimen adherence among this population? Our approach draws upon a large, nationally-representative sample of older adults. Further, we consider the effects of social relationships and regimen support separately. Finally, we examine socio-demographic variation in the study of social support, adherence, and health decline. Using this approach, this analysis has the potential to inform policy and practice interventions.

Conceptual/Theoretical Framework

We use the Health Decision Model (HDM) as a framework to capture the relative contribution of social support in enhancing adherence and health outcomes among

diabetic older adults. The HDM, from Eraker, Kirscht, and Becker (1984), builds upon Becker's Health Belief Model by incorporating preferences, including decision analysis and behavioral decision theory. The HDM has been used to examine patient adherence to smoking cessation interventions (Eraker et al. 1985) and racial differences of health-related beliefs, attitudes, and experiences of cardiac patients (Kressin et al. 2002), and can also be used to frame the analysis of the relationship between health decline among diabetics, social support, and regimen adherence. According to this model, health decisions and behavior (such as short and long term compliance) are influenced by sociodemographic characteristics and social interactions (social networks, support, and patient supervision). However, these factors also influence a patient's experience with—and knowledge about—the illness (including disease, diagnostic and therapeutic interventions, and health care providers). Patient experience and knowledge independently influence outcomes (including adherence), but have an additional interacting effect on patient preferences (decision-making processes) and health beliefs (specific and general).

This model is particularly useful for examining the relationship between social support and health outcomes (including adherence) among chronically ill patients with a complex regimen, as it emphasizes that patient adherence is a function of numerous complex factors, which change according to a patient's disease attitudes and over time (Eraker et al. 1984). Further, the model suggests that individual adherence does not necessarily translate into positive health outcomes, which can be moderated by other factors such as health beliefs and decisions. Finally, although few studies have comprehensively addressed the social distribution of support (House et al. 1988; Thoits

1995; Turner and Marino 1994), studies have found that that socio-demographic characteristics such as race/ethnicity and gender can moderate this relationship (Connell, Sorandt and Lichty 1990; Connell, Fisher and Houston 1992; Fitzgerald et al. 1997; Gallant 2003). Social status has been found in previous research to increase the odds of diabetic prevalence in midlife as well as health behaviors and disease management following diagnosis (Wray et al., 2006). Lower social position is a risk factor for earlier disease onset and worse management in mid-life. Even holding health behaviors constant later in life, the disease prevalence and health behaviors earlier can strongly predict health outcomes among elderly diabetics.

In conclusion, the HDM suggests several mechanisms through which social support can influence health outcomes and adherence among the chronically ill, including type 2 diabetics. However, the HDM does not suggest which competing forms of social support (social relationships/networks, informal care, or illness support) would be strongest in this relationship. As argued by Coyne and Delongis (1986), there is a need to go beyond social support to investigate determinants of health and well being to further examine the relative influences of social support on health outcomes, including adherence (Gallant 2003). Here, drawing on the HDM, we contribute to the literature on social support and health outcomes by examining the relationship between social support (focusing on illness-related support but controlling for other aspects) and disease outcomes: regimen adherence and overall health decline among diabetic older adults.

Hypotheses

To address our research questions, we propose the following two hypotheses, which are followed by two separate analyses:

Hypothesis 1: Illness-related support is negatively associated with health status decline

Hypothesis 2: Regimen adherence is negatively associated with health status decline

Methods

Sample

To conduct our two analyses: (a) examining the impact of social support on regimen adherence and health decline over time, and (b) examining the relationship between regimen adherence and distal health outcomes, we will analyze data from the Health and Retirement Study (HRS) waves six and seven (2002 and 2004) as well as the 2003 Diabetes Supplement. HRS is a national, population-based study that has tracked individuals and households over a twelve-year period. The HRS 2003 Diabetes Study is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and was conducted by the University of Michigan (Survey Research Center).

In 1992, 12,654 community-dwelling individuals born from 1931-1941 participated in the study (response rate 81.7%). Adjusting for respondent mortality, the response rates have remained above 84 percent in the six subsequent waves, with a sample size of 10,142 individuals in wave six (2002) and 9,759 individuals in wave 7 (2004). The 2003 Diabetes Supplement was fielded to the 2,381 cases (a) reporting a diagnosis of diabetes in the 2002 HRS and (b) eligible for the supplemental examination (not participating in the HRS Consumption and Activities Mail Survey). This mailed

survey requested information pertinent to a variety of domains, including data on medications for diabetes, provider interactions, and co-morbidities. Data from this questionnaire can be linked with the larger HRS sample by unique case identifiers. Questionnaires were returned by 1,901 respondents (a response rate of 79.8%).

Data Weighting and Analytic Sub-Sample

Of those returning questionnaires for the Diabetes Supplement, 1851 reported that they had type 2 diabetes (1603) or did not indicate which type (248). The remainder of cases reported having type 1 diabetes (50). Of the 1851, 1788 reported having one or more elements of the diabetes regimen (discussed below) and followed up for the seventh survey wave in 2004. Given that self-reported diabetes diagnosis has been found to be a valid and reliable indication (when compared with laboratory tests), we will restrict our study population to those indicating a positive diagnosis of type 2 diabetes mellitus or unknown diabetics types with an age of onset over 30 years (Kaye, et al. 1991; Midthjell, et al. 1992). Weights were constructed to adjust for attrition and sampling bias to generate unbiased estimates for 2003 mail-out respondents specifically.

Measures

Dependent Variable: Decline in self-rated health from 2002-2004 is the outcome variable in the first analysis (the relationship between illness-related support and health decline). An indicator variable (*health decline*) was constructed to determine if health from the preceding wave (a) got worse or (b) maintained or improved. In 2002, respondents indicated whether they would rate their overall health as excellent, very good, good, fair, or poor. Those reporting a value upon follow-up of at least one unit of

poorer overall health were labeled as having experienced health decline. Overall health status is a categorical variable in the 2002 HRS study, with 15% reporting excellent health, 32% reporting that their health is “very good”, 35% reporting “good”, 15% reporting “fair”, and 2% reporting poor health.

Health change is contingent upon health status; therefore, this outcome variable is controlled by overall self-reported health status. Self-reported and self-assessed measures have been used widely in epidemiological and social research. This global categorical measure (self-rated health on a 1-5 scale) has been found to be highly concordant with clinical assessments, as well as a reliable predictor of mortality and health care utilization (Idler and Benyamini 1997). For the second part of the analysis (testing the relationship between self-assessed illness-related support and reported adherence), the dependent variable is self-reported adherence to the six diabetic regimen components.

Independent Variables: A diabetic regimen is ideally customized through the patient-provider interaction to optimize adherence and successful treatment. While the extent may vary, the prevention of diabetic complications generally calls for the following as regimen components:

- Taking diabetes medications (pills and/or insulin);
- Exercising regularly;
- Following a recommended eating plan;
- Checking blood sugar;
- Checking feet for wounds or sores; and
- Seeing doctors or other providers.

In the 2003 Diabetes Supplement, subjects indicated (through a 5-point Likert scale) the extent to which they can rely on family or friends to provide help and support for each regimen component (*illness-related support*). For each component, subjects also indicated level of difficulty, or to which degree they adhered to each regimen component, ranging from “so difficult that I couldn’t do it at all” to “not difficult; I got it exactly right” (*adherence*). Respondents had the option of indicating if a component was not part of their regimen, in which case that response is excluded from the analysis.

A global dichotomous adherence measure is used in the first analysis to test the primary hypothesis (and shown in Tables 2.1 and 2.2 and Models 1-3, discussed below). Individuals are coded as relatively adherent who report relatively high levels of compliance with their overall diabetic regimen, while respondents are coded as relatively non-adherent who report relatively low levels of compliance. In the second analysis, to test the second hypothesis (see Table 2.3), health status is regressed on the six different components of the diabetic regimen discussed above, with the Likert-scale maintained.

As discussed above, social support has been conceptualized and measured differently in the literature. In this study, we will focus on illness-related social support, while using support-related characteristics (provision of informal/unpaid care and social relationships) as alternative measures of support included in the analysis as covariates. Our rationale for focusing on illness- or adherence-related support in our analysis is that—as mentioned above—previous literature has suggested that adherence is the most probable mechanism for the negative relationship between health decline and support. Including additional variables related to support as covariates will enable us to

peripherally examine alternative explanations for such a relationship, provided it is found.

In the first analysis, social support for regimen components is examined with health decline, controlling for regimen adherence and health status/morbidity. For the second analysis, social support components are examined with adherence, controlling for health status, change, and additional control variables. *Health status* is obtained from the 2002 HRS and categorically measured through a 5-point Likert scale self-assessing overall health from poor to excellent. *Morbidity* is measured by an imputed variable of the Total Illness Burden Index (TIBI) score of comorbidities from the HRS 2004 Tracker File. The TIBI is a composite measure of self-reported medical events and symptoms (Greenfield et al. 1995). Finally, *duration of diabetes* is determined by subtracting the age of diabetes diagnosis (Diabetes Supplement 2003) from current age (HRS Tracker File 2004). The consideration of health status/morbidity in the analysis enables us to statistically isolate health decline from the potentially collinear effect of overall health.

Control Variables

We are concerned with two relationships in this study: (1) The relationship between social support and health status change among the chronically ill; and (2) The relationship between social support and regimen adherence. While the dependent and independent variables described above enable these analyses, social support might influence health change and adherence through other mechanisms, such as the direct provision of diabetes-related care or the health effects of companionship in old age.

Marital status and *Informal diabetes caregiving* will therefore be used to measure these

competing aspects of social support. The former is obtained through the 2004 HRS respondent tracker file, with "1" indicating married and "0" a collapsed variable including divorced, widowed, separated, and never married. *Informal diabetes caregiving* is captured from the Diabetes Supplement question, "Besides your health care providers, who helps you the most in caring for your diabetes?" Respondents indicating spouse, other family members, or friends are determined to have informal diabetes caregivers. Respondents indicating "paid helper" or "nobody" are determined not to have informal diabetes caregivers.

The measured covariates (marital status and receipt of informal care) do not perfectly capture alternative forms of social support. For example, individuals who are currently married might have more interaction with a marital partner than those who are divorced, widowed, separated, and never married; however, this does not include life partners, closer personal friends or contact with direct or extended family, community involvement, or friendships. Further, the receipt of informal/unpaid care is not *necessarily* indicative of a higher level of support than the receipt of paid care or no care, paid or unpaid. For example, previous research has suggested that roles between formal and informal care can overlap or cross over in payment or relationship (Allen and Ciambrone 2003; Porter, Ganong, Drew and Lanes 2004). That said, receipt of informal care has been raised as an alternative explanation for the relationship between social support and distal health outcomes. Including informal care as a covariate will enable illness-related support to be distinguished from the direct provision of care.

As previous research suggests (Connell et al. 1990; Connell et al. 1992; Fitzgerald et al. 1997; Gallant, 2003), social support and health status for the chronically ill can vary

across such factors as race, socioeconomic status, gender, and age, which could potentially bias this analysis. Using demographic data from the 2002 HRS Tracker file, *gender* (male/female), *race/ethnicity* (Black, Hispanic, and White), and *age* are used as controls in this analysis. In addition, *educational achievement* (less than high school; completion of high school; and some college or more) is used as a proxy control variable for socioeconomic status. The education variable is chosen as a proxy over other concrete statuses (such as income or attained wealth) because education is stable, while other indicators are highly variable at different stages of the earnings and retirement process. Measures are coded into categories to enable more a more intuitive and meaningful interpretation of descriptive and analytical statistics. For the purposes of preliminary descriptive statistics, age and education levels are analyzed in groups. Four equal-range age groups are analyzed from 60-69 to 90-99. These groupings are intended to capture the relationship between social support, adherence, and health status change among different socio-demographic groups.

A series of statistical procedures is employed to test the hypotheses concerning social support, regimen adherence, and health status decline. As discussed below, descriptive statistics on social, health, and demographic variables will provide preliminary data on sample characteristics. The hypotheses are tested through a series of binomial and ordinal logistic regression models, respectively. All analyses are weighted for non-response and differential subgroup sampling, unless otherwise indicated. Sampling weights were used from the 2003 diabetes mail-out study (type 2 diabetics represent over 90% of the sample).

Descriptive statistics are calculated to examine sample characteristics among respondents experiencing health decline. The characteristics explored are demographic variables (age group, gender, years of education, and race), health and diabetes variables (self-rated health, diabetes duration, and morbidity), and social variables (marital status, informal diabetes care). Within these categorical groups, weighted proportions and standard errors are reported as well as the unweighted count of respondents in each category.

Models

Hypothesis 1

A series of multivariate logistic regression models will enable us to test the hypothesis that social support is negatively associated with health status decline, controlling for regimen adherence, health status, and additional covariates:

Model 1: In the first model, the six social support regimen variables are regressed on the indicator variable for health decline, controlling for age and self-rated health in 2002. This analysis will provide a preliminary, age- and health-adjusted indication of the relationship between support and health status decline.

Model 2: The second model will include the same regimen social support variables as in Model 1, but will also include core (and competing) social relationship variables of marital/coupled status and receipt of informal care. This will enable an independent evaluation of the strength of influence of different forms of support on health decline.

Model 3: The final model includes the core social support variables, social variables, and health and diabetes-related variables (reported regimen adherence, duration of diabetes, and morbidity). The final model enables us to better control for illness severity and individual-level behaviors, as well as for the additional demographic characteristics gender, years of education, and race/ethnicity.

Hypothesis 2

Finally, to examine the second hypothesis that illness support is positively associated with adherence, we will conduct a series of ordinal (cumulative probability) logistic regressions. In each of the six models, illness support is regressed on its corresponding attribute of regimen adherence (e.g. adherence to a meal plan regimen would be the outcome variable and support from family/friends for meal plans is the explanatory variable). All health and diabetes related variables, social variables, and demographic control variables are included in the series of regressions.

Results

Sample Characteristics

Table 2.1: Distribution of Study Variables in HRS Population, Weighted and Unweighted

	Unwgt. and Missing	Unwgt. %	Wgt. %
Support and Regimen Variables			
Regimen Support			
Taking Medications	1,632 (83)	96.25	96.03
Exercise Regularly	1,443 (104)	86.22	84.49
Follow Meal Plan	1,515 (128)	91.69	91.41
Check Blood Sugar	1,196 (129)	72.51	71.63
Check Feet	1,522 (78)	89.53	90.01
Provider Appointments	1,326 (155)	81.63	80.56
Regimen Adherence	1,048 (298)	70.60	70.42
Married/Coupled	1,171 (0)	66.00	62.68
Informal Care	396 (134)	24.12	24.42
Health Variables			
Health Decline (2002)	179 (9)	10.06	9.41
Demographic Variables			
Age Group			
60-69	560 (0)	31.54	36.44
70-79	714 (0)	40.10	34.55
80-89	417 (0)	23.43	23.78
90-99	88 (0)	4.92	5.25
Female	921 (0)	51.79	50.78
Education			
Less than High School	638 (0)	33.17	32.93
High School Graduate	558 (0)	35.74	33.85
Some College or More	553 (0)	31.10	33.21
Race/Ethnicity			
White (non-Hispanic)	1,234 (4)	69.45	75.17
Black (non-Hispanic)	351 (3)	19.84	15.35
Hispanic/Latino Origin	190 (4)	10.70	9.47
Sources: Health and Retirement Study Tracker File (2004); Health and Retirement Study (2004); Health and Retirement Study – Diabetes Supplement (2003)			
*Significant at p<.05			

Table 2.1 compares weighted and unweighted samples in several factors to assess the impact of over-sampling and non-response bias. This table demonstrates that the sample population is highly representative of the older adult diabetic population. The sample population is roughly similar in terms of age, gender, and education characteristics as the general population. Blacks and Hispanics are slightly over-represented due to purposive over-sampling. The weighted sample proportion reporting having support related to diabetes regimen components was high, ranging from nearly 72% for checking blood sugar to over 96% for taking medications. Over 70% of the weighted sample reported following their diabetes regimen. The majority of weighted respondents were married (63%), while a minority received informal care from friends or family (24%). Although the unweighted sample had nearly identical proportions as the weighted sample in regimen support, and adherence domains, the sample disproportionately represented those with poor and fair health, justifying the use of survey weights in this analysis due the complex design.

Preliminary Diagnostics

The proportion of the sample experiencing declining health varies by demographic, health/diabetes status, and social characteristics. Specifically, the proportion reporting declining health was positively associated with age (highest burden in age group 80-89), being female (37 percent versus 32 percent), and fewer years of education. As expected, health decline was strongly related to poor health with the follow-up, with 79 percent of the individuals reporting poor health who had experienced health decline. Duration of diabetes and TIBI were generally positively associated with health decline. Finally, among the additional social variables examined here (marital

status and provision of diabetes care by friends/family), the proportions of those reporting health decline were surprisingly similar, ranging from 34-35 percent.

Multivariate Analysis: Binomial Logistic Regression Models

Table 2.2: Logistic Regression Analysis of the Probability of Health Status Decline

	Model 1		Model 2		Model 3	
	OR (SE)	p-value	OR (SE)	p-value	OR (SE)	p-value
Regimen Support						
Taking Medications	0.859 (.207)	0.529	0.799 (.189)	0.344	0.734 (.189)	0.23
Exercising Regularly	1.397 (.338)	0.167	1.382 (.329)	0.174	1.444 (.355)	0.136
Exercising Regularly	0.957 (.172)	0.805	1.032 (.183)	0.857	0.943 (.171)	0.745
Checking Blood	0.895 (.150)	0.508	0.961 (.155)	0.803	0.888 (.144)	0.464
Checking Feet	1.247 (.287)	0.337	1.231 (.280)	0.361	1.343 (.345)	0.251
Provider Appointments	1.063 (.166)	0.696	1.212 (.210)	0.267	1.253 (.235)	0.228
Age	0.972 (.011)	.013*	0.973 (.011)	.017*	0.978 (.134)	0.115
Married/Coupled	- -	-	0.947 (.209)	0.806	0.914 (.235)	0.228
Informal Care	- -	-	1.832 (.507)	.029*	1.975 (.628)	.032*
Diabetes Duration	- -	-	- -	-	1.007 (.012)	0.528
TIBI	- -	-	- -	-	1.011 (.007)	0.111
Sex (ref: female)	- -	-	- -	-	0.961 (.209)	0.854
Regimen Adherence	- -	-	- -	-	0.961 (.231)	0.868
Self-Rated Health 2002	-1.500 (.145)	.000*	1.506 (.146)	.000*	1.551 (.197)	.001*
Sources: Health and Retirement Study – Diabetes Supplement (2003); Health and Retirement Study (2004); Health and Retirement Study Tracker File (2004)						
*Significant at p<.05						

Model 1: Among the six illness support variables tested on health decline, none were statistically significant. Self-rated health and age were highly significant as predicted.

Model 2: With the inclusion of the social relationships variables, support variables continued not to be significant. Being married or coupled was not significantly associated with health status decline, while the receipt of informal care was strongly positively

associated with decline (83%). Age and self-rated health remained statistically significant as predicted.

Model 3: In the final model diabetes support variables remained non-significant. Further, the competing measures of social support (marital status and receipt of informal care) changed little from previous model, a reduction in the odds of decline of 8% and increase of 97.5%, respectively. The illness support variables of interest remained stable with the inclusion of the additional health, diabetes-related, and socio-demographic variables. Self-reported regimen adherence was slightly negatively associated with decline (3.9%), while diabetes duration and TIBI slightly positively associated with decline. We did not find significant differences by gender. Further, education level was not statistically associated with decline when comparing respondents with education below high school to high school graduates; however, individuals with education above a high school level had 45% lower odds of health decline compared to high school graduates, which was significant. Relative to whites, Blacks did not significantly differ in health decline; however, Hispanics had significantly higher odds of health decline relative to whites.

Multivariate Analysis: Ordinal Logistic Regression Models

Table 2.3: Ordinal Logit Analyses of Social Support on Regimen Adherence

Social Support Regimen Variable	OR (Std. Err)	Coef (Std. Err)	Adj. Wald Test	Prob>F	DEFF
Medications	1.5869 (.1681)	.4618 (.1059)	11.35	.0008*	1.5619
Exercising	1.6961 (.1397)	.5283 (.0824)	44.9	<.0001*	1.3501
Eating Plan	2.0963 (.2164)	.7402 (.1032)	58.44	<.0001*	1.3422
Check Blood Sugar	1.6171 (.1530)	.4806 (.0946)	27.35	<.0001*	1.3321
Check Feet	1.6406 (.1431)	.4951 (.0872)	29.82	<.0001*	1.3991
Providers Appts.	1.6116 (.1715)	.4772 (.1064)	15.52	.0001*	1.3707
Source: Health and Retirement Study – Diabetes Supplement (2003)					
*Significant at p<.05					

The series of ordinal logistic regression models tested the relationship between illness support and component regimen adherence, controlling for all other factors included in Model 3. Each highly significant, we find a one-level increase in social illness increases the odds of adherence to the regimen by percentages of 59 (medications), 61 (appointments), 62 (checking blood sugar), 62 (checking feet), 70 (exercising), and 110 (following eating plan).

Discussion

This research examined the relationship between illness support and health status, with regimen adherence at its center. We were able to analyze—through six different regimen components—the association of support, adherence, and health status decline over a two-year period. The finding that illness-related support was not significantly associated with distal health outcomes (but that illness-related support was significantly related to adherence) challenges previous assumptions that regimen adherence will necessarily translate into improved (or maintained) health outcomes. This is—to our

knowledge—a unique finding. Further research should examine the mechanisms underlying—as well as endogeneity and temporal issues related to—the protective and risk-associated behaviors associated with illness support. Given that the period of health change is only two years, it is possible that illness-related support could be operating in numerous ways. Support might be increased during the time that health is in rapid decline, indicating a “need for support intervention” from friends and family. Given that these directions generally remained stable and consistent throughout the models, they should be explored in prospective quantitative and qualitative research. These relationships vary significantly by age, health status, race/ethnicity, and years of education, suggesting that illness support operates differently in socio-demographic domains. In addition, the degree to which isolation is a risk factor, or to which support has a buffering effect, warrants further investigation.

These models also enabled us to test the extent to which illness support might be confounded by social relationships or receipt of informal care. The latter was consistently significant. The extent to which illness support is associated with regimen adherence is of particular concern. From the series of ordinal logistic regressions, we were able to assert that illness support is significantly associated with adherence for each regimen component tested here, controlling for other factors. These findings are consistent with previous literature examining the relationship between illness support and regimen adherence among chronically ill populations—particularly diabetics (Connell et al. 1990; Connell et al. 1992; Gallant 2003; Sherbourne et al. 1992; Wilson et al. 1986).

This relationship between illness support, adherence, and health outcomes does not conflict with Eraker and colleagues’ (1984) Health Decision Model, which suggests

that health determinants might relate to outcomes in a non-linear fashion. This study marks a stepping-stone in the elucidation of the “black box” of social support theory into tangible mechanisms of its relation to health status, and how it varies by sociodemographic attributes. We learned that illness support (and reported adherence) might not translate into improved health outcomes, as indicated in this study of diabetics over a period of two years.

Despite the advantages of this study, there are several noteworthy limitations. First, a period of two years might not adequately capture the translation of regimen adherence into prevention of health decline. Second, we rely heavily on subjective measures of health, which—though commonly used in health and social research—measure only a limited aspect of health status. Further, subjective health status—and self-reported health decline—could further be impacted by psychosocial factors. For example, research has suggested that chronically ill older adults who rate their health more optimistically will have relatively greater perceived control over their illnesses (Hong, Oddone, Dudley, and Bosworth 2005). As a result, we re-ran our analyses with variables measuring aspects of disease outcome optimism and disease self-efficacy. Although there were minor changes in the coefficients we reported, our key findings remained consistent.

In addition, our analysis of health decline as a dependent variable relies not only on an appropriate measurement of health status, but also on the appropriate measure of change. By assessing decline, we introduce some error into our analysis in the form of a “floor effect”, whereby those reporting poor health at baseline cannot report relatively worse health. However, given that the number of respondents reporting poor health at

baseline is very small (less than 3%), it is unlikely that this imposes biases on our overall findings. We suggest that future research should examine the complex pathways of health status and functional limitations (maintenance, decline, improvement) as health trajectories, with multiple periods of observation and over an extended period of time.

We were not able to examine additional measures of social support found to be significant in previous health research (social networks and ties, community involvement and participation), as well as other important predictors in the HDM (such as health beliefs and knowledge). Further, the availability of self-reported adherence measures (support for diabetes activities, regimen adherence variables) only with the 2003 Supplement poses limitations on analyzing the full relationship over time. In addition, the analysis was restricted to individuals reporting a full diabetic regimen (consisting of the six regimen components). Missing data on the outcome variable, health and diabetes variables, social variables, and demographic variables was negligible and apparently missing at random (or addressed through weighting). An imputation was conducted on item missing data and did not significantly change the outcomes, so the original data (with sampling weights from the 2003 mail-out study) were kept. Sampling weights adjusted for non-response (including subject mortality). Finally, all measures used in this analysis were based on self-report, which, as mentioned above, might impose some systematic bias on the results of this study. However, given the relative stability of coefficients and standard errors across different models as well as previous studies on the validity and reliability of psychometric measures used in this analysis, it is unlikely these findings are heavily impacted by a large degree of measurement error (see Alwin 2007).

Conclusion

The relationship between illness support, adherence, and health is nuanced and multi-faceted. Diabetic support appears to be associated as protective for some regimen components but a susceptibility factor for others. Diabetic support is, however, highly associated with adherence for each regimen attribute, controlling for other factors. Future research should examine the strength of these relationships in different subgroups of the population, particularly by race/ethnicity, by socioeconomic status, and by gender. Finally, as this study seeks to understand the role of illness support within the context of health and illness, much of the texture of these disease pathways are lost. Subsequent analyses—qualitative and quantitative—are necessary to better understand how support influences health trajectories and disease pathways for different groups. Such research can shed light on potential protective factors of social support for individuals and communities.

References

- Ajrouch, K. J., Antonucci, T. C., & Janevic, M. R. (2001). Social networks among blacks and whites: The interaction between race and age. *Journal of Gerontology: Social Sciences, 56*, S112-S118.
- Allen, S. M., & Ciambone, D. (2003). Community care for people with disability: Blurring boundaries between formal and informal caregivers. *Qualitative Health Research, 13*, 207-226.
- Alwin, D. F. (2007). *Margins of error: A study of reliability in survey measurement*. New York: Wiley.
- American Diabetes Association (1998). Economic consequences of diabetes mellitus in the U.S. in 1997. *Diabetes Care, 21*, 296-309.
- Bae, S., Hashimoto, H., Karlson, E. W., Liang, M. H., & Daltroy, L. H. (2001). Variable effects of social support by race, economic status, and disease activity in systemic lupus erythematosus. *Journal of Rheumatology, 28*, 1413-1422.
- Belgrave, F. Z., & Lewis, D. M. (1994). The role of social support in compliance and other health behaviors for African Americans with chronic illnesses. *Journal of Health and Social Policy, 5*, 55-68.
- Berkman, L. F., & Syme, S. L. (1979). Social networks, host resistance, and mortality: A nine-year follow-up of Alameda County residents. *American Journal of Epidemiology, 109*, 186-204.
- Blaum, C. S., Ofstedal, M. B., Langa, K. M., & Wray, L. A. (2003). Functional status and health outcomes in older Americans with diabetes mellitus. *Journal of the American Geriatrics Society, 51*, 735-897.
- Blazer, D. (1982). Social support and mortality in an elderly community population. *American Journal of Epidemiology, 115*, 684-694.
- Cohen, S., & Gottlieb, B. H. (2000). *Social support measurement and intervention: A guide for health and social scientists*. New York: Oxford University Press.
- Connell, C. M., Fisher, E. B., & Houston, C. A. (1992). Relationships among social support, diabetes outcomes, and morale for older men and women. *Journal of Aging and Health, 4*, 77-100.
- Connell, C. M., Sorandt, M., & Lichty, W. (1990). Impact of health belief and diabetes-specific psychosocial context variables on self-care behavior, metabolic control, and depression of older adults with diabetes. *Behavior Health and Aging, 1*, 183.
- Coyne, J. C. & DeLongis, A. (1986). Going beyond social support: The role of social relationships in adaptation. *Journal of Consulting and Clinical Psychology, 54*, 454-460.

- Durkheim, E. (1951). *Suicide*. [1897] New York: Free Press.
- Eraker, S. A., Becker, M. H., Strecher, V. J., & Kirscht, J. P. (1985). Smoking behavior, cessation techniques, and the Health Decision Model. *The American Journal of Medicine*, 78, 817-825.
- Eraker, S. A., Kirscht, J. P., & Becker, M. H. (1984). Understanding and improving patient compliance. *Annals of Internal Medicine*, 100, 258-68.
- Everard, K. M., Lach, H. W., Fisher, E. B., & Baum, M. C. (2000). Relationship of activity and social support to the functional health of older adults. *Journal of Gerontology: Social Sciences*, 55, S208-S212.
- Fitzgerald, J. T., Anderson, R. M., Funnell, M. M., Arnold, M. S., Davis, W. K., Amam, L. C., Jacober, S. G., & Grunberger, G. (1997). Differences in the impact of dietary restrictions on African Americans and Caucasians with NIDDM. *Diabetes Educator*, 23, 41-47.
- Gallant, M. P. (2003). The influence of social support on chronic illness self-management: A review and directions for research. *Health Education and Behavior*, 30, 170-195.
- Gore, S. (1989). Social networks and social supports in health care. In H. E. Freeman and S. Levine (Eds.), *Handbook of Medical Sociology* (4th ed., pp. 306-331). Englewood Cliffs, New Jersey: Prentice Hall.
- Greenfield, S., Sullivan, L., Dukes, K. A., Silliman, R., D'Agostino, R., & Kaplan, S. (1995). Development and testing of a new measure case mix for use in office practice. *Medical Care*, 33(suppl), AS47-AS55.
- Health and Retirement Study, 2003 Diabetes Study. Produced and distributed by the University of Michigan with funding from the National Institute on Aging (grant number NIA UG01AG009740). Ann Arbor, MI, (2006).
- Heisler, M., Smith, D. M., Hayward, R. A., Krein, S. L., & Kerr, E. A. (2003). How well do patients' assessments of their diabetes self-management correlate with actual glycemic control and receipt of recommended diabetes services? *Diabetes Care*, 26, 738-745.
- Hill-Briggs, F. (2003). Problem solving in diabetes self-management: A model of chronic illness self-management behavior. *Annals of Behavioral Medicine*, 25, 182-193.
- Hong, T. B., Oddone, E. Z., Dudley, T. K., & Bosworth, H. B. (2005). Subjective and objective evaluations of health among middle-aged and older veterans. *Journal of Aging and Health*, 17, 592-608.
- House, J. S., Landis, K., & Umberson, D. (1998). Social relationships and health. *Science*, 241, 540-45.

- House, J., Robbins, C., & Metzner, H. (1982). The association of social relationships and activities with mortality: Prospective evidence from the Tecumseh Community Health Study. *American Journal of Epidemiology*, *116*, 123-140.
- Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A Review of twenty-seven community studies. *Journal of Health and Social Behavior*, *38*, 21.
- Kaplan, G., Salonen, J., Cohen, R., Brand, R., Syme, S., & Puska, P. (1988). Social connections and mortality from all causes and cardiovascular disease: Prospective evidence from Eastern Finland. *American Journal of Epidemiology*, *128*, 370.
- Kaplan, H. (1989). Social psychology of disease. In H. E. Freeman and S. Levine (Eds.), *Handbook of Medical Sociology* (4th ed., pp. 53-70). Englewood Cliffs, New Jersey: Prentice Hall.
- Kaplan, H., Cassel, J. C., & Gore, S. (1977). Social support and health. *Medical Care*, *15*, 47-58.
- Kaye, S. A., Folsom, A. R., Sprafka, J. M., Prineas, R. J., & Wallace, R. B. (1991). Increased incidence of diabetes mellitus in relation to abdominal adiposity in older women. *Journal of Clinical Epidemiology*, *44*, 329-334.
- Kohn, M. L., & Clauson, J. A. (1955). Social isolation and schizophrenia. *American Sociological Review*, *20*, 265-273.
- Krause, N., & Borawski-Clark, E. (1994). Clarifying the functions of social support in later life. *Research on Aging*, *16*, 251-279.
- Kressin, N. R., Clark, J. A., Whittle, J., East, M., Peterson, E. D., Chang, B., Rosen, A. K., Ren, X., Alley, L. G., Kroupa, L., Collins, T. C., & Peterson, L. A. (2002). Racial differences in health-related beliefs, attitudes, and experiences of VA cardiac patients: Scale development and application. *Medical Care*, *41*, Supplement, I-72-I85.
- Langa, K. M., Vijan, S., Hayward, R. A., Chernew, M. E., Blaum, C. S., Kabeto, M. U., Weir, D. R., Katz, S. J., Willis, R. J., & Fendrick, A. M. (2002). Informal caregiving for diabetes and diabetic complications among elderly Americans. *Journal of Gerontology: Social Sciences*, *57B*, S177-S186.
- Midthjell, K., Holmen, J., Bjorndal, A., & Lund-Larsen, F. (1992). Is questionnaire information valid in the study of chronic disease such as diabetes? The Nord-Trondelt Diabetes Study. *Journal of Epidemiology and Community Health*, *46*, 537-42.
- Peyrot, M., McMurry, J. F., & Hedges, R. (1987). Living with Diabetes: The role of personal and professional knowledge in symptom and regimen management. *Research in the Sociology of Health Care*, *6*, 107-146.
- Porter, E. J., Ganong, L. H., Drew, N., & Lanes, T. I. (2004). A new typology of home-care helpers. *The Gerontologist*, *44*, 750-759.

- Ruggiero, L. A., Spirito, A., Bond, A., Constan, D., & McGarvey, S. (1990). Impact of social support and stress on compliance in women with gestational diabetes. *Diabetes Care* 13, 441-443.
- Sarason, B. R., Sarason, I. G., & Gurung, R. A. (2001). Close personal relationships and health outcomes: A key to the role of social support. In B. R. Sarason & S. Duck (Eds.) *Personal relationships: Implications for clinical and community psychology* (pp. 15-41). New York: Wiley.
- Schoenbach, V., Kaplan, B., Freedman, L., & Kleinbaum, D. (1986). Social ties and mortality in Evans County, Georgia. *American Journal of Epidemiology*, 123, 577-591.
- Schulz, A. J., Israel, B. A., Zenk, S. N., Parker, E. A., Lichtenstein, R., Shellman-Weir, S., & Klem, L. (2006). Psychosocial stress and social support as mediators of relationships between income, length of residence and depressive symptoms among African American women on Detroit's eastside. *Social Science & Medicine*, 62, 510-522.
- Seeman, T. E., Kaplan, G. A., Knudsen, L., Cohen, R., & Guralnik, J. (1987). Social network ties and mortality among the elderly in the Alameda County Study. *American Journal of Epidemiology*, 126, 714-723.
- Sherbourne, C. D., & Hays, R. D. (1990). Marital status, social support, and health transitions in chronic disease patients. *Journal of Health and Social Behavior*, 31, 328-343.
- Thoits, P. A. (1995). Stress, coping, and social support processes: Where are we? What next? *Journal of Health and Social Behavior*, 35, 53-79.
- Turner, R. J., & Marino, F. (1994). Social support and social structure: A descriptive epidemiology. *Journal of Health and Social Behavior*, 35, 193-212.
- Uchino, B. N. (2004). *Social support and physical health outcomes: Understanding the health consequences of our relationships*. New Haven, CT: Yale University Press.
- Wills, T. A., & Filer, M. (2001). Social networks and social support. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 209-234). Mahwah, NH: Erlbaum.
- Wilson, W., Ary, D. V., Biglan, A., Glasgow, R. E., Toobert, D. J., & Campbell, D. R. (1986). Psychosocial predictors of self-care behaviors and glycemic control in NIDDM. *Diabetes Care*, 9, 614-622.
- Wray, L. A., Alwin, D. F., & McCammon, R. J., Manning, T., & Best, L. E. (2006). Social status, risky health behaviors, and diabetes in middle-aged and older adults. *Journal of Gerontology: Social Sciences*, 61B: S290-S298.

Chapter 3

Health Decline in Older Adults with Diabetes: Are Race/Ethnicity and Socioeconomic Status Independent Predictors of Long-term Outcomes?

Abstract

Racial/ethnic and socioeconomic factors are tested as independent predictors of health decline for older adults with type 2 diabetes. Data come from the 1992-2006 Health and Retirement Study and were analyzed through multi-level modeling. The sample includes 2,494 diabetics over the age 65. Blacks and Hispanics had significantly lower proportional odds of better health over time than whites. These effects weakened, but remained significant after controlling for socioeconomic factors. Assets were significantly associated with higher odds of better health. In contrast to our hypothesis, those with higher education (relative to those with less than high school) had significantly lower proportional odds of better health. Income and high school completion were not significant predictors. The model suggests cumulative effects over time, offering support to life course and cumulative disadvantage theories. Given the multiple linkages among dimensions of stratification, research on chronic illness must consider race/ethnicity and socioeconomic status as independent predictors of long-term health.

Introduction

Diabetes mellitus has transitioned from a disease of the socially privileged to one plaguing disadvantaged populations. The CDC (2003) reports that the age-adjusted prevalence of diabetes differs greatly between whites (4.7 percent), Hispanics (6.9), and non-Hispanic blacks (7.4). Further, cross-sectional and longitudinal studies of diabetics have shown socioeconomic disparities in excess mortality (Howard et al., 2000), functional status (Kingston & Smith, 1997), and cognitive functioning (Bent et al., 2000). Nevertheless, cross-sectional trends only indicate aggregate sociodemographic trends and shifts and ignore the individual- and group-level variability of the outcomes of chronic illness. This experience varies greatly between individuals, between groups, and over the life span. As argued by House (2002), there is a need to examine the social factors that influence how social disparities shape the causes and consequences of illness—linking proximal to distal, “fundamental causes” of illness (Link & Phelan, 1995). The present study of health outcomes among older adults with diabetes is situated within this paradigm. This study of how health pathways differ by race/ethnicity and by socioeconomic status in older adulthood will be driven by the Life Course Health and Development (LCHD) framework (Elder, 1998; Halfon & Hochstein, 2002).

Mechanisms underlying Health Disparities: Race/Ethnicity and Socioeconomic Status

Racial and ethnic⁵ disparities in health have long been documented in the sociological and public health literature. The underlying mechanisms include a number of

⁵ In this analysis, race and ethnicity using Williams (1997) definition of the “confluence of biological factors and geographic origins, cultural, economic, political and legal factors, as well as racism”.

proximal and distal causes, such as differing health behaviors (Escarce et al., 2006; Harris et al., 1999; Heisler et al., 2007), medical decision-making and disparities in quality and access to high-quality care (Bradley et al., 2002; Smedley et al., 2003; van Ryn & Fu, 2003), and cumulative effects of discrimination (Wyatt et al., 2003). These mechanisms are intertwined with—and therefore difficult to distinguish from—socioeconomic disadvantage, which has been linked to health generally through, for example, relative and absolute disadvantage (Black et al., 1982; Wilkinson, 1996), neighborhood effects and residential segregation (Schulz et al., 2002; Williams & Collins, 2001), and access to care (Keeler, 1992).

This relationship is particularly salient in the context of diabetes and other chronic illnesses, due to later-in-life divergence of health status by SES (Hayward et al., 2000; House, et al., 1994). Further, considering socioeconomic factors as a life-course exposure is crucial for understanding diabetes disparities because of the high degree to which diabetes can be prevented and controlled (Phelan et al., 2004; Lutfe & Freese, 2005), and intervening early in life could prevent development of diabetes or lessen its negative sequelae. Most studies examining social position find that indicators are positively associated with health outcomes—even controlling for race—yet we continue to lack understanding of clear mechanisms by which these factors relate to the onset or severity of chronic illnesses such as diabetes (Connolly et al., 2000; Hayward et al., 2000; Robbins et al., 2001). Although the relationship between SES and general health outcomes has been established in the literature (Haas, 2008; Heiss et al., 2003), the measures of SES are inconsistent. In most studies, socioeconomic variables are used as controls with other explanatory ‘effects’ examined. Directly analyzing and focusing on

SES enables statistical models to be more appropriately specified to include multiple aspects of SES—and the potential causal pathways therefore better addressed. Research must also include multiple measures of SES as people age.

Longitudinal Health Outcomes: Race / Ethnicity and SES Disparities

Longitudinal research – particularly studies examining panel data over multiple waves – has provided some insight into the mechanisms through which race/ethnicity and socioeconomic status operate independently or in conjunction to generate and exacerbate health disparities. Despite the progress in the research in this area, the strong debate remains concerning the cause of disparities in long-term chronic illness outcomes: race/ethnicity, socioeconomic status, a combination of these, or neither. The findings generally fall under several camps: those that find that, controlling for socioeconomic status, the racial gap disappears, remains, or those that find that it is contingent upon other factors.

Studies that exclusively examine the relationship between various measures of socioeconomic status and health decline find positive relationships between social position and longitudinal health outcomes (or, from a different perspective, that poverty is associated with a more rapid decline in health). These studies find, with some exceptions (McDonough & Berglund 2003), that spells of wealth and poverty predict subsequent health outcomes (McDonough et al., 2005; Willson et al., 2007), which may differ by cohort (Lynch, 2003) or the level of inequality of the society in which one lives (Kennedy et al., 1998).

The majority of research examining the influence of race/ethnicity on long-term health decline has found that the relationship becomes insignificant after socioeconomic factors are included in the models. For example, research examining black/white health disparities in long-term breast cancer outcomes found that racial differences in survival are explained by socioeconomic status (Bradley et al., 2002; Dayal et al., 1982). Research focusing on the progression of multiple chronic illnesses has also found that—despite racial disparities in health outcomes among the chronically ill—the racial/ethnic gap in health outcomes is no longer significant after economic stratification is taken into consideration (Hayward et al., 2000; Kingston & Smith, 1997; Robert & Lee, 2002). Studies examining general health decline and disablement have come to similar conclusions when taking incident morbidity into account (Ferraro et al., 1997; Kelley-Moore & Ferraro, 2004; Peek et al., 1997).

A number of studies have found that after controlling for socioeconomic characteristics, racial/ethnic status remains a strong predictor of health status as people age. In contrast to research discussed above, for example, several studies found strong interaction effects between race/ethnicity and sociodemographic characteristics. For example, Shuey and Willson (2008) found that income disparities between whites and blacks accounted for racial differences in health pathways; however education was less protective against health decline for blacks relative to whites. These findings were supported by a study by Farmer and Ferraro (2005) which found SES and race to be independent and significant predictors of health decline over time. Further, a recent study by Liang and colleagues (2010) found that when examining health trajectories, the disparities between Whites, Blacks, and Hispanics grow over time net of education. Other

studies have found that while the race/ethnicity effects might no longer be significant once controlling for socioeconomic status in general, significant results do remain for subgroups of the populations studied, such as those who experience racism and discrimination (Nazroo, 2003; Williams 1999), those holding specific cultural beliefs (Lannin et al., 1998), or those living in poorer neighborhoods (Browning et al., 2003). A recent study by Liang et al. (in press) found that Hispanic-white differences in health outcomes are largely mediated by SES while black-white disparities do remain significant controlling for SES, suggesting different mechanisms underlying these disparities. Previous research suggests that diabetes prevalence and complication rates differ, with the greatest disease burden carried by socially disadvantaged groups (although the source of disadvantage—race/ethnicity, SES, or both, remains hotly debated).

This study incorporates the life course framework and examines race/ethnicity and socioeconomic status as predictors for functional decline over time. This study analyzes race/ethnicity and socioeconomic status indicators in models independently and in conjunction with one another to better examine these layered forms of disadvantage. Further, this study allows for different measures of SES over time, contributing to the health disparities literature by addressing what aspects of socioeconomic position influences health decline.

Conceptual/Theoretical Framework

This study contributes to current research in several ways. First, it will examine whether or not race/ethnicity and socioeconomic characteristics are independent

predictors of health decline among older adults with type 2 diabetes over time. Second, it will take the dynamic nature of respondents' lives into consideration through analyzing both time-constant and time-varying characteristics. This will enable us to examine how socioeconomic characteristics and race/ethnicity – both independently and in concert – predict the rate of decline of health status among older, chronically ill adults. Finally, it will examine whether these relationships hold after controlling for individual-level health covariates such as body mass index, level of insurance coverage, and number of comorbidities. Following the LCHD framework, I hypothesize that there are racial/ethnic and SES differences in diabetes outcomes over time. Specifically, I hypothesize that these disparities persist net of health care access and health behavior.

Theoretical Model: The Life Course Health and Development (LCHD) Framework

The above hypotheses will be evaluated with the LCHD framework. The key principles of life course theory—an interdisciplinary framework used to guide research and inquiry—include: (a) historical time and place; (b) timing of lives; (c) linked or interdependent lives; and (d) human agency (Elder, 1998). Since its application to the relationship between social structure and the life course (Cain, 1964), life course theory has proven a useful and powerful mechanism for capturing individual, group, and period effects on subsequent circumstances. In the health and illness framework, LCHD theory frames “the varying exposure to health risks experienced by individuals and groups either before or during birth, in childhood, or at various stages in adult life” (Gabe et al., 2004, p. 50) among populations and subgroups. Specifically, it examines the role of risk factors, protective factors, and how life experiences influence the health outcomes of individuals (Halfon & Hochstein, 2002). Further, the LCHD framework emphasizes the role of

critical periods, sensitive stages, and cumulative effects in health, illness, development, and aging (also referred to as cumulative advantage or cumulative disadvantage).

Cumulative advantage was discussed by Merton (1988) as the mechanisms of ~~initial~~ comparative advantage of trained capacity, structural location, and available resources make for successive increments of advantage such that the gaps between the haves and the have-nots . . . widen” (p. 606). Since that time, numerous studies have addressed disparities in health and aging from a life-course perspective through the lens of cumulative advantage/disadvantage, such as Dannefer (2003), Ferraro et al. (2006), Kahn and Pearlin (2006), and Shuey and Willson (2008). Cumulative disadvantage also recognizes that social advantages in a society (such as race/ethnicity and socioeconomic status) are structurally linked, which can exacerbate inequalities over time for disadvantaged groups.

The LCHD framework has been frequently drawn upon to examine the onset and severity of chronic illnesses in early, mid- or late life among individuals and populations. Studies have suggested intergenerational and early life predictors of chronic illness (Davey Smith et al., 2000; Eriksson et al., 2001; Gillman, 2004). Researchers have also used the LCHD framework to examine the relationship between chronic disease outcomes and social stratification, such as race/ethnicity (Ferraro et al., 1997) and socioeconomic status (House et al., 1994; Stroschein, 2005), and interactions between them (Kahn & Fazio, 2006). The LCHD framework has primarily been used to explain early-life predictors of the *event* of chronic conditions later in life, such as heart disease, obesity, and diabetes (Forouhi et al., 2004), although a few studies have integrated adult risk factors in the analysis (Lamont et al., 2000). Few studies have optimized the LCHD

framework in the quantitative analysis of health over longitudinal tracking studies (House et al., 2005; Liang et al., 2010). These studies incorporating life course theory and the LCHD framework have suggested that chronic illnesses should not be examined in a ‘slicethrough time’—rather, there are biological, psychological, social, and economic determinants throughout the life course that influence the onset, progression, and experience of chronic illness (Kuh & Ben-Schlomo, 2004). While life course theory is an ideal type and cannot fully be quantified in research, this framework is a useful tool for examining how life circumstances and events—including social stratification by race/ethnicity and socioeconomic status—alter the susceptibility, illness behavior, and disease outcomes. This research focuses on life course determinants of health outcomes later among chronically ill populations in late life.

Research Design and Methods

Research Hypotheses

To address these research questions, the following hypotheses are proposed concerning the study population (older adults with type 2 diabetes):

Hypothesis 1 (H₁): Relative to non-Hispanic whites, non-Hispanic blacks and Hispanics are more likely to experience sharper rates of health decline (H_{1a}). These differences will remain even after controlling for socioeconomic status (H_{1b}).

Hypothesis 2 (H₂): Higher levels of socioeconomic status will be positively and independently associated with a steadier rate of health decline, as measured by education

(H_{2a}), income (H_{2b}), and wealth (H_{2c}). Further, socioeconomic differences in health disparities will remain strong even after controlling for race/ethnicity (H_{2d}).

Hypothesis 3 (H₃): As suggested by previous literature, differences in health across dimensions of social stratification are partially mediated by regimen adherence and access to health care. While these mechanisms will be significant, racial differences will remain controlling for access to health care (measured by private health insurance) (H_{3a}) and adherence (measured by the proxy body mass index) (H_{3b}). Similarly, socioeconomic differences will remain after controlling for insurance (H_{3c}) and bmi (H_{3d}).

To examine these hypotheses, longitudinal data is examined that spans 12 years. Data were collected biennially, with a maximum of 8 repeat observations. Data are drawn from the Health and Retirement Study (HRS) and its associated Assets and Health Dynamics among the Oldest Old (AHEAD) using the RAND (2008) combined data files and imputations. HRS (and the incorporated AHEAD sample) is a national, population-based study that has tracked individuals and households since 1992. The first cohort (1992) included 12,654 community-dwelling individuals born from 1931-1941, with a response rate of 81.7%. Adjusting for mortality, the response rates have remained above 84% in the seven subsequent biennial waves. Additional respondents are integrated into the study through new cohort recruitment and through marriage to a HRS respondent. As of the 2006 survey, the combined dataset now includes comprehensive data from nearly 27,000 respondents. The HRS is sponsored by the National Institute of Aging (NIA U01AG009740) and is conducted by the University of Michigan.

Analytic Sample

The analytic sample consists of 2,494 diabetic individuals who participated in at least 3 survey waves (those who became diabetic during the period of analysis are only included in the waves after which they report having type 2 diabetes). As this study focuses on older adults, the sample was restricted to respondents the age of 65 years or greater at the time of a given wave's interview. Finally, 54 respondents of unknown or "other" ethnicity (not reporting non-Hispanic white, black, or Hispanic in any waves) were also excluded to maintain statistical power in examining racial and ethnic differences in health status between these three groups.

Observations are in the form of person-year through multi-level analysis; therefore, the analytic sample includes 2,494 respondents but a total of 19,061 observations. Despite original over-sampling of Hispanics and African Americans by HRS at baseline, the sample, unweighted in this analysis, over-represents older adults still living. In the analytic sample, subject mortality following the first wave in which a respondent reported being diabetic differed very slightly by group, including race/ethnicity (White: -0.02; Black: 0.05; Hispanic: -0.03), level of education (less than high school: 0.09; high school: -0.04; college: -0.05). The analytic sample of observations was 55% female, 74% white, 7% Hispanic, and 19% black. Approximately 45% have not completed high school, while 31% have completed high school and 25% have completed some college or more (see Table 3.1 for sample statistics).

Dependent and Explanatory Variables Analyzed

The outcome variable throughout this analysis is a time-varying *self-reported health status* (the respondent's self-assessed general health status in the wave of data

collection). Self-assessed measures of health have been used widely in epidemiological and social research. This global ordinal variable is highly concordant with clinical assessments, as well as a reliable predictor of mortality and health care utilization (Idler & Benyamini, 1997). For the purposes of this analysis, self-reported health status is examined in cumulative probabilities of reporting given health value as well as mean- and value-based probabilities for preliminary and descriptive statistics. Values were recoded to reflect 5 (excellent), 4 (very good), 3 (good), 2 (fair), and 1 (poor).

To examine the relationship between race/ethnicity and longitudinal health outcomes, *race / ethnicity* categories were assigned by looking at reports from all waves of data for race. Respondents initially identified as White/Caucasian, Black/African American, or Other. When asked whether Hispanic or non-Hispanic, respondents were categorized as Hispanic according to the first non-missing value answered. Therefore, three mutually exclusive categories of non-Hispanic white, non-Hispanic black, and Hispanic were created that remain consistent across waves.

The measure of *education* (at baseline) was used to examine the relationship between socioeconomic status and long-term health outcome. The cross-wave highest degree categorical variable is assigned by utilizing the first non-missing value across survey waves. Three distinct categories were generated, including less than high school (some high school or less), high school (high school or GED), and some college or more (AA, BA, or graduate-level education) as well as time-varying measures of household *income* (in \$100s), household *assets* (in \$1000s), and whether or not the respondent is currently working. The wave-specific measure of *total household income* (in \$100s) is the sum of all income in the household, including income from household capital,

pensions and annuities, Social Security retirement, DI, or SSI benefits, unemployment and worker's compensation, veteran's benefits, welfare, and food stamps, and other income sources such as alimony, pension, and inheritance. RAND imputed missing income data (RAND, 2009) and adjusted for slight variations in questions across waves. The wave-specific measure *total household assets* (in \$1000s) is the net value of total wealth minus all debt, including primary and secondary residences, and assets (IRAs, stocks, checking, savings, bonds, CDs, business, and other assets). Debts (including mortgages and other debts) are subtracted from positive assets to equal the final value. When an item is missing, it is imputed according to RAND's (2009) criteria⁶.

Covariates Analyzed

The additional independent variables of theoretical interest are whether or not the respondent has *private health insurance* (in addition to Medicare) and time-varying *body mass index (bmi)*. Additional *control variables* include the time-varying *working status*, and time-constant measures of *gender* and maximum number of *chronic illness comorbidities* (at baseline) in addition to diabetes. The variable *private health insurance* (at baseline) was generated with subsequent negative responses replacing positive responses, suggesting long-term private health insurance (in addition to public Medicare) into retirement. Time-varying *bmi* was calculated as weight divided by the square of height. Height is carried forward to impute for missing cases. For the time-varying *working status*, respondents were posed the question "Are you currently working for pay?" Missing data were imputed by RAND based on related questions in some waves

⁶ Education, household income, and household assets were generally not highly correlated: the highest correlation was 0.5 (between household assets and household income). Analyses were also tested with only income (in which income was slightly significant) and with only assets (in which assets were slightly more significant) – as well as subsequent analyses – suggested that this high correlation is not driven by a variable omitted from this analysis.

(i.e. “are you working now?”). Respondents were asked by wave whether or not they are covered by health insurance from their (and/or their spouse’s) current or previous employer. Finally, a time-constant ordinal variable was created to measure *chronic illness comorbidities (comorbidity)*. The variable is calculated by summing the maximum number of chronic illnesses at baseline (1-5+): high blood pressure, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis.

Analytic Strategy

A series of statistical procedures were used to test the hypotheses concerning health status, race/ethnicity, and socioeconomic status. As discussed below, descriptive statistics on the social, health, and demographic characteristics will provide preliminary data on sample characteristics. The hypotheses will be tested through a series of three ordinal logistic multilevel models (Raudenbush & Bryk, 2002; Rabe-Hesketh & Skondral, 2005). Rather than analyzing socioeconomic status and race/ethnicity together in a single model, separate models are used to examine the relationships between these characteristics and health. Finally, the third model incorporates socioeconomic status, race/ethnicity, as well as the model covariates. Together, the models enable the independent and aggregate analysis of the relationship between race/ethnicity and health as well as socioeconomic status and health. Both are important as socioeconomic status and race/ethnicity have been found to correlate strongly, but there is much debate in the literature regarding causal relationships. Nevertheless, these forms of stratification remain structurally linked in stratified societies.

The ordinal logistic model is appropriate for the analysis of the dependent variable due to ordinal rank from 1 (poor) to 5 (excellent), which considers floor, ceiling effects, and skewness more than does an OLS regression model. An important feature of the multilevel model is the assumption that the intercept (ζ_{1j}) and slope (ζ_{2j}) parameters of self-reported health status vary across individuals (and interact with time as person-year), so that they become dependent variables in the level two (or person-level) model, where individual characteristics are included as predictors. This is particularly important as self-rated health observations have been found to be significantly associated with prior self-rated health outcomes (Miller & Wolinsky, 2007):

$$\begin{aligned} \text{logit} \{ \Pr(y_{ij} > s \mid x_{ij}, \zeta_{1j}, \zeta_{2j}) \} &= \beta_1 + \beta_2 x_{2ij} + \beta_3 x_{3j} + \beta_4 x_{2j} x_{3ij} + \zeta_{1j} + \zeta_{2j} x_{2ij} - k_s \\ &= (\beta_1 + \zeta_{1j}) + (\beta_2 + \zeta_{2j}) x_{2ij} + \beta_3 x_{3j} + \beta_4 x_{2j} x_{3ij} - k_s \end{aligned}$$

As shown in the model above, not only the intercept but also the slope ($\beta_2 + \zeta_{2j}$) of the year squared (x_{2ij}) vary over respondents (i). We assume that, given x_{ij} , the random intercept and slope have a bivariate normal distribution with zero mean and that both the random intercepts and random slopes are independent across respondents. Additional time constant and time-varying variables are discussed below. To obtain parsimony and due the number of models that are analyzed in this study, full equations for each model are not presented here. All analyses were conducted using Stata.

Model 1: The first model tests whether or not non-Hispanic blacks and Hispanics experience a steeper rate of decline in self-rated health than non-Hispanic whites (H_{1a}) and that non-Hispanic whites will have steadier rates of health decline relative to non-Hispanic blacks and Hispanics controlling for insurance status (H_{3a}) and bmi (H_{3b}).

Racial/ethnic variables and all health-related and sociodemographic covariates, excluding socioeconomic measures were included in the model.

Model 2: The second model tests the hypotheses that socioeconomic measures predict rate of health decline. Specifically, it examines whether—as hypothesized, those with lower levels of education (relative to those with less than high school) experienced successively steeper rates of health decline (H_{2a}), whether increases in income in \$100/year increments are associated with steadier rates of decline (H_{2b}), and whether increases in wealth of \$1000 is associated with steadier rates of decline of self-rated health (H_{2c}). Further, the model addresses whether socioeconomic differences will remain after controlling for insurance (H_{3c}) and bmi (H_{3d}). Finally, socioeconomic measures and all health-related and sociodemographic covariates are included, excluding race/ethnicity from the model.

Model 3: The final model tests the hypothesis that – relative to non-Hispanic whites, Hispanics and non-Hispanic blacks will, respectively, have steeper rates of self-reported health decline over time, controlling for socioeconomic covariates (H_{1b}). The third model also addresses the hypothesis that socioeconomic differences in health disparities will remain significant even after controlling for race/ethnicity (H_{2d}). This model includes all measures.

Table 3.1: Distribution of Self-Rated Health by Health Status: 1992-2006

Sample: 2,493 Total: 19061	Sample Distribution			Self-Rated Health				
	Unwgted. N	Wgted. Prop./ Mean	Wgted. Error	1 (Poor)	2	3	4	5 (Excellent)
Race / Ethnicity	2494							
Non-Hispanic White (ref)	1846	0.74	0.61	0.27 (503)	0.30 (548)	0.27 (502)	0.13 (244)	0.03 (49)
Non-Hispanic Black	467	0.19	--	0.31 (147)	0.38 (178)	0.21 (100)	0.00 (35)	0.01 (7)
Hispanic	181	0.07	--	0.27 (49)	0.44 (79)	0.23 (41)	0.06 (10)	0.01 (2)
Mean Hhd Assets (in \$1000s)	10342	0.23	0.48	0.14 (699)	0.19 (805)	0.33 (643)	0.40 (289)	0.36 (58)
Mean Hhd Income (in \$100s)	10342	0.30	0.57	0.25 (699)	0.25 (805)	0.37 (643)	0.37 (289)	0.42 (58)
Education	2493							
1. Less than High School	1133	0.45	0.64	0.35 (395)	0.36 (406)	0.20 (226)	0.08 (86)	0.02 (20)
2. High School / GED	774	0.31	--	0.25 (194)	0.29 (224)	0.31 (239)	0.13 (100)	0.03 (17)
3. Some College or more	586	0.24	--	0.19 (109)	0.30 (175)	0.30 (178)	0.18 (103)	0.04 (21)
Age	10340	77.66	0.06	80.47 (689)	80.98 (805)	80.78 (643)	80.73 (289)	80.83 (58)
Sex	2494							
Male	1114	0.45	0.50	0.27 (301)	0.32 (352)	0.27 (299)	0.12 (133)	0.03 (29)
Female (ref)	1380	0.55	--	0.29 (398)	0.33 (453)	0.25 (344)	0.11 (156)	0.02 (29)
Working Status	2486							
Currently Working	2382	0.09	0.28	0.10 (10)	0.25 (26)	0.39 (41)	0.19 (20)	0.07 (7)
Not Currently Working	104	0.92	--	0.29 (685)	0.33 (777)	0.25 (600)	0.11 (269)	0.02 (51)
Comorbidity	2494							
0 (other than diabetes)	115	0.21	1.29	0.06 (7)	0.27 (31)	0.40 (46)	0.18 (21)	0.09 (10)
1	310	0.33	--	0.16 (50)	0.28 (86)	0.31 (97)	0.22 (69)	0.03 (8)
2	639	0.44	--	0.19 (124)	0.32 (204)	0.31 (201)	0.14 (89)	0.03 (21)
3	722	0.45	--	0.29 (209)	0.35 (255)	0.24 (172)	0.10 (71)	0.02 (15)
4	473	0.39	--	0.40 (188)	0.33 (157)	0.19 (91)	0.07 (35)	0.00 (2)
5 or more	234	0.30	--	0.51 (120)	0.31 (72)	0.15 (36)	0.02 (4)	0.01 (2)
Health Insurance	2274							
No Private Health Insurance	1317	0.58	0.49	0.31 (411)	0.34 (447)	0.22 (293)	0.10 (134)	0.02 (32)
Private Health Insurance	957	0.42	--	0.21 (197)	0.31 (296)	0.32 (305)	0.15 (139)	0.02 (20)
Body Mass Index (BMI)	10207	27.49	5.02	26.27 (687)	26.91 (794)	27.09 (629)	26.68 (287)	26.79 (57)
Mortality	2494	0.29	0.45	0.29 (699)	0.32 (805)	0.26 (643)	0.23 (289)	0.02 (58)
Significance Levels: p<.001 (***), p<.05 (**), p<.01 (*)								

Descriptive Statistics

Table 3.1 shows that self-rated health status varies by socio-demographic, socioeconomic, and health characteristics. Specifically, those with more income and assets are strongly represented in the “very good” and “excellent” health categories, whereas those with fewer assets and income are more likely to fall in the “fair” and “poor” categories. Those with less education are also more highly represented in worse health categories relative to those with more education. For example, among those with less than a high school degree, 35% of the sample reports poor health, 35% fair, 20% good, 8% very good, and 2% excellent health. Among those with a high school degree or equivalent, 25% report poor health, 29% fair, 31% good, 13% very good, and 3% excellent. Respondents with some college or more are less represented in poor health (19%), but are more represented than most groups in all other categories (30% fair, 30% good, 18% very good, 4% excellent). Bmi and gender were fairly evenly distributed across categories. Those who are currently working, have private health insurance, and have fewer comorbidities are over-represented in better health categories.

As shown in Tables 3.1 and 3.2, differences can be observed in self-reported health status by race/ethnicity. For example, non-Hispanic whites are generally overrepresented in the “good” (27%) “very good” (13%) and “excellent” (3%) health categories, compared to non-Hispanic blacks (21%, less than 1%, and 1%, respectively), and Hispanics (23%, 6%, and 1%, respectively). Non-Hispanic whites are generally less represented in the “poor” (27%) and “fair” (30%) health categories compared with non-Hispanic blacks (31%, 38%) and Hispanics (27% and 44%). Non-Hispanic whites also are more socioeconomically advantaged than the other groups in the sample, with

relatively greater assets, income, and education relative to non-Hispanic blacks and Hispanics, respectively.

Table 3.2: Distribution of Self-Rated Health by Race/Ethnicity: 1992-2006

	Sample Distribution			Race / Ethnicity					
	Unwgted. N	Wgted. Prop./ Mean	Wgted. Error	Non-Hispanic White		Non-Hispanic Black		Hispanic / Latino	
Self-Rated Health	2494	2.28	1.06						
1	699	0.28	--	0.72	(503)	0.21	(147)	0.07	(49)
2	805	0.32	--	0.68	(548)	0.22	(178)	0.10	(79)
3	643	0.26	--	0.78	(502)	0.16	(100)	0.06	(41)
4	289	0.12	--	0.84	(244)	0.12	(35)	0.03	(10)
5	58	0.02	--	0.84	(49)	0.12	(7)	0.03	(2)
Mean Hhd Assets (in \$1000s)	10342	0.23	0.48	0.28	(7730)	0.06	(1800)	0.07	(812)
Mean Hhd Income Yr (in \$100s)	10342	0.30	0.01	0.34	(7730)	0.17	(1800)	0.14	(812)
Education	19016	2.67	0.64						
1. Less than High School	1776	0.09	--	0.88	(1560)	0.09	(168)	0.03	(48)
2. High School / GED	2696	0.14	--	0.88	(2368)	0.10	(272)	0.02	(56)
3. Some College or more	14544	0.76	--	0.70	(10144)	0.21	(3104)	0.09	(1296)
Sex	19032								
Male	8552	0.45	0.50	0.78	(6688)	0.15	(1296)	0.07	(568)
Female (ref)	10480	0.55	--	0.71	(7400)	0.21	(2248)	0.08	(832)
Working Status	10320			0.10	(734)	0.06	(113)	0.04	(36)
Not Currently Working	880	0.09	0.28	0.90	(796)	0.94	(825)	0.96	(845)
Currently Working	9440	0.91	--	0.10	(7713)	0.06	(1796)	0.04	(811)
Comorbidity	19024	2.75	1.29						
0 (other than diabetes)	840	0.04	--	0.73	(616)	0.17	(144)	0.10	(80)
1	2304	0.12	--	0.73	(1672)	0.18	(408)	0.10	(224)
2	4880	0.26	--	0.72	(3496)	0.21	(1016)	0.08	(368)
3	5528	0.29	--	0.73	(4032)	0.20	(1088)	0.07	(408)
4	3640	0.19	--	0.77	(2808)	0.16	(600)	0.06	(232)
5 or more	1832	0.10	--	0.79	(1456)	0.16	(288)	0.05	(88)
Health Insurance	17304								
Private Health Insurance	7344	0.42	0.49	0.83	(6064)	0.14	(1048)	0.03	(232)
No Private Health Insurance	9960	0.58	--	0.68	(6808)	0.21	(2104)	0.11	(1048)
Body Mass Index (BMI)	10207	27.49	5.02	27.32	(7667)	28.17	(1751)	27.63	(789)
Mortality	15357								
Mortality	4475	0.29	0.45	0.72	(3223)	0.22	(980)	0.06	(272)
No Mortality	10882	0.71	--	0.74	(8082)	0.18	(1924)	0.08	(876)

Significance Levels: p<.001 (***), p<.05 (**), p<.01 (*)

As shown in Tables 3.1 and 3.2, differences can be observed in self-reported health status by race/ethnicity. For example, non-Hispanic whites are generally overrepresented in the “good” (27%) “very good” (13%) and “excellent” (3%) health categories, compared to non-Hispanic blacks (21%, less than 1%, and 1%, respectively), and Hispanics (23%, 6%, and 1%, respectively). Non-Hispanic whites are generally less represented in the “poor” (27%) and “fair” (30%) health categories compared with non-Hispanic blacks (31%, 38%) and Hispanics (27% and 44%). Non-Hispanic whites also are more socioeconomically advantaged than the other groups in the sample, with relatively greater assets, income, and education relative to non-Hispanic blacks and Hispanics, respectively.

These descriptive statistics offer support to the first and second hypotheses—that race/ethnicity and socioeconomic status appear to be strong predictors of health outcomes. Further, there appears to be racial/ethnic and socioeconomic differences in individual-level characteristics such as private health insurance and body mass index. However, given that these data are pooled and do not take mortality into consideration, the validity of these preliminary descriptive is very limited.

Table 3.3: Multi-level Proportional-Odds Models Predicting Self-Rated Health, 1992-2006

	Model 1					Model 2					Model 3							
	OR	Std. Err	z	95% CI		Sign	OR	Std. Err	z	95% CI		Sign	OR	Std. Err	z	95% CI		Sign
Race (ref: NH White)																		
Non-Hispanic Black	0.614	0.081	-3.68	0.473	, 0.796	***	-	-	-	-	-	-	0.701	0.091	-2.73	0.543	, 0.905	**
Hispanic / Latino	0.592	0.113	-2.75	0.407	, 0.860	**	-	-	-	-	-	-	0.684	0.128	-2.03	0.474	, 0.988	**
Socioeconomic Status																		
Household Assets (in 1000s)	-	-	-	-	-	-	1.391	0.125	3.68	1.167	, 1.658	***	1.342	0.119	3.31	1.127	, 1.596	***
Household Income (in 100s)	-	-	-	-	-	-	1.074	0.069	1.11	0.947	, 1.218	-	1.068	0.068	1.02	0.942	, 1.210	-
Education (ref: less than HS)																		
High school	-	-	-	-	-	-	1.046	0.206	0.23	0.711	, 1.539	-	1.026	0.201	0.13	0.699	, 1.506	-
College or more	-	-	-	-	-	-	0.644	0.110	-2.57	0.460	, 0.900	**	0.666	0.113	-2.39	0.477	, 0.930	**
Sex (ref: female)																		
Currently working	2.746	0.666	-0.37	1.708	, 4.417	***	2.376	0.570	3.61	1.485	, 3.802	***	2.370	0.565	3.62	1.486	, 3.780	***
Comorbidity	0.534	0.031	-10.7	0.476	, 0.599	***	0.552	0.031	-10.58	0.495	, 0.616	***	0.547	0.031	-10.7	0.490	, 0.611	***
Private health insurance	1.481	0.154	3.78	1.208	, 1.815	***	1.417	0.144	3.43	1.161	, 1.729	***	1.361	0.139	3.03	1.115	, 1.662	**
Body mass index	1.012	0.010	1.22	0.993	, 1.030	-	1.012	0.009	0.21	0.993	, 1.030	-	1.013	0.009	1.42	0.995	, 1.032	-
Model Characteristics																		
Log Likelihood	-2942.62					-2928.521					-2923.391							
Condition Number	2811.638					2865.067					2861.017							
Level 1 and Level 2 Units	2233, 2125					2232, 2124					2232, 2141							
Var/Covar of Random Effects	var (1) lev 2: 1.355 (-0.573)					var (1) lev 2: 1.24 (-0.542)					var (1) lev 2: 1.198 (-0.534)							
Significance Levels: p<.001 (***), p<.05 (**), p<.01 (*)																		

Results

Race/Ethnicity

As shown in Model 1 in Table 3.3, non-Hispanic blacks had a significantly lower proportional odds of better health status over time than non-Hispanic whites (0.61, $p < .0001$). Hispanics reported significantly lower proportional odds better health over time relative to non-Hispanic whites (0.59, $p < .05$) and compared to non-Hispanic blacks, controlling for gender, working status, number of comorbidities, private health insurance, and bmi. When including the socioeconomic status variables (education, household assets and income) to the analysis in Model 3, the effect of race/ethnicity is reduced but remains significant ($p < .05$), controlling for gender, working status, number comorbidities, private health insurance, and bmi. Controlling for socio-economic characteristics, the differences between non-Hispanic whites (the reference group) and non-Hispanic blacks and Hispanics in the proportional odds of better health narrowed (0.70, 0.68, $p < .05$) from the previous model, but significant differences remain. Including socioeconomic status did not remove the health effects of race/ethnicity among non-Hispanic blacks and Hispanics, although the effect did weaken in magnitude and statistical significance.

Socioeconomic Characteristics

Model 2 (Table 3.3) examines whether favorable socioeconomic characteristics are predictive of the proportional odds of better health status over time. This model controls for sociodemographic and health-related factors but excludes race/ethnicity from the analysis. Compared to those with less than a high school degree, those with a high school degree or equivalent did not differ significantly, while those with some college or

more had 0.64 proportional odds of better health status over time ($p < .05$). Household income was not a significant predictor, but household assets were significantly associated with improved proportional odds of better health. When race/ethnicity is included in Model 3, the relationship and significance of the sociodemographic characteristics remain but again weaken in magnitude. For example, the coefficient for household assets decreases slightly from 1.39 to 1.34 (at $p < .001$). Higher levels of education (some college or more) remains a significant predictor of lower proportional odds of better health over time (0.67, $p < .05$) while those with a high school degree or equivalent did not have significantly different odds than those with who had not completed high school, controlling for all socio-demographic and health covariates.

Socio-Demographic and Health Covariates

In the full model, gender was not a significant predictor of proportional odds of better health. Working status was significantly associated with higher proportional odds (2.37 at $p < .001$), while each additional chronic illness comorbidity was associated with significantly reduced proportional odds (0.55 at $p < .001$) of better health over time. Private health insurance status was protective against health decline (1.36 at $p < .05$), while bmi was not significantly associated with proportional odds of better health over time.

To test whether or not this modeling strategy (random slope, random intercept proportional odds model) is a better fit than a model with a fixed slope, a likelihood-ratio test was performed. In this model, the subject-specific proportional odds per unit of time (in years squared), the p-value is close to zero, suggesting that the random-coefficient

proportional odds model is a better fit than the fixed slope model. Further, the covariance structures in each model suggested greater declines in health status among non-Hispanic blacks and Hispanics (relative to non-Hispanic whites) and among those with asset levels below the mean (relative to those with asset levels above the mean). The steeper rate of decline in the models with the random slopes provides support to the theory of LCHD and the corresponding theory of cumulative advantage/disadvantage. As time progresses, socially disadvantaged groups experience cumulatively worse health outcomes over time.

Discussion and Limitations

This research examined the complex relationships between health status, race/ethnicity, and socioeconomic status among older diabetics in the US, taking into consideration key individual level variables raised as potential explanations for health disparities in previous research. In this study, race/ethnicity was a significant predictor of proportional odds of better health, with non-Hispanic whites faring much better than Hispanics and non-Hispanic blacks. Although the proportional odds (and – in the case of non-Hispanic blacks – the level of significance) did decrease while adding socioeconomic variables to the analysis, race/ethnicity remained a strong and significant predictor of health decline, providing support to the first hypothesis (H_{1a} , H_{1b}). As these factors remained significant while controlling for private health insurance and body mass index, this offers support to the hypotheses that racial differences will remain controlling for insurance and bmi (H_{3a} and H_{3b}).

Some socioeconomic characteristics were protective against health decline over time. For example, household assets were a consistent predictor of improved proportional odds, while income remained insignificant. Relative to those with less than a high school degree, having a high school degree or equivalent was not associated with significantly improved proportional odds of better health, while having post-secondary education was significantly associated with worse health over time. This provides support to the hypotheses that wealth significantly predicts better health outcomes over time (H_{2c}) and that socioeconomic differences remain when controlling for race/ethnicity (H_{2d}), support was not found for the hypotheses that greater levels of education and income significantly predict better health outcomes over time (H_{2a} and H_{2b}) for older adults with type 2 diabetes.

As hypothesized, these relationships remained significant controlling for bmi and health insurance (H_{3c} and H_{3d}). The findings that – controlling for other factors – lower levels of body mass index and higher levels of education were not significantly associated with improved proportional odds of better health suggests that health literacy or health behavior might not be the panacea to improved long-term outcomes among chronically ill older adults. Further, it suggests that education—a seasoned proxy variable for socioeconomic status—might not capture determinants of differing health outcomes later in life for this specific period and age group. Rather, more attention should be provided to the “fundamental causes” of these disparities (House, 2002; Link & Phelan, 1995) and how they exacerbate over time. These findings are concordant with the LCHD framework. These findings also offer support to the related theory of cumulative advantage, as racial/ethnic and socioeconomic disparities are exacerbated over time. To

gain a more elaborate understanding of the causal relationships between these structurally linked characteristics and health status, additional analysis is needed of direct and indirect effects of socioeconomic status and race/ethnicity measures as mediating factors, interactions, and group-specific analyses. To further examine the mechanisms and processes underlying these divergent paths of health, it is necessary to further examine what, for example race/ethnicity represents from a lifecourse perspective, such as health discrimination, segregation, or cumulative effects of racism (Wyatt et al., 2003; Nazroo, 2003; Williams, 1999; Williams & Collins, 2001) among older adults. Further, access to private insurance in addition to Medicare could represent greater continuity of care which could be associated with better self-care behaviors, outcomes, or earlier disease discovery among diabetics (Parchman et al., 2002). Additional characteristics that should be examined in future studies include the interactive relationships between race/ethnicity and SES and stress (Pearlin et al., 2005), neighborhood characteristics, and quality of care from a lifecourse perspective.

The proposed study has several limitations. Health is a multi-faceted and complex state, not limited to self-reported health status. Further, the study relies primarily on self-reported data, which could introduce bias of differential expectations by group. The global categorical measure (self-rated health on a 1-5 scale) has been found to be highly concordant with clinical assessments, as well as a reliable predictor of mortality and health care utilization (Idler & Benyamini, 1997). This analysis does account for differential expectations partially by examining changes among the same individuals over time; however, it is feasible that the individuals change their reference categories over time as their social position or health status also changes, which might introduce bias

(Wolinsky & Tierney, 1998). Nevertheless, this study's heavy reliance on self-reported data limits the validity of the findings.

The populations to which these findings can be generalized are older adults with diabetes in the US. The decision to focus on older adulthood was made to focus on specific cohort-related changes (such as retirement, Medicare insurance), and how these differences might vary by social position. As discussed earlier, subject mortality is not strongly associated with race/ethnicity or with levels of education. As with most longitudinal studies of older adults, subject mortality could bias the results. The longitudinal multi-level model does take into consideration subject mortality (respondents are not dropped from the analysis if they experience attrition through non-response or mortality). Although subsequent analyses suggest attrition and proxy interviews had only a marginal effect on the findings, if any, mortality could introduce bias into the analysis. Respondents who died during the study period (29% of the sample) were over-represented reporting having poor or fair health prior to their death relative to those who did not die during the study period. Assuming this sample remains representative of older adults with diabetes, that should not limit generalizations too greatly as this is analysis of the natural history of a chronic disease and mortality should not exclude the natural event of mortality from the process. An additional concern is mortality prior to the age of 65. Previous studies (Kapteyn et al, 2006) have found that HRS mortality is significantly more likely among non-whites, which might make the race/ethnicity estimates somewhat conservative. The HRS sample provides individual prospective tracking data beginning in middle age or older adulthood, limiting the ability

to analyze—and make generalizations to—a full life-course model, including the influence of childhood factors (Haas, 2008).

Finally, although this analysis was conceptualized from a life-course perspective, the relationship between health and disease status and social characteristics is nuanced and multi-faceted. More research is needed that focuses on the intersectionality of this group, suggesting that the disadvantage is not simply additive or interactive, but could be multiplicative. As researchers seek to understand how these factors shape illness patterns throughout the life-course, much of the texture of the disease pathway is lost by slicing in time after the age of 65. Subsequent analysis, using a mixed-methods approach (possibly including prospective studies, life history calendars, and in-depth interviews) are necessary to better understand how social forces fundamentally shape illness experiences, outcomes, and how chronic illness unfolds over the remainder of the life course.

References

- Bent, N., Rabbitt, P., & Metcalfe, D. (2000). "Diabetes mellitus and the rate of cognitive ageing". *British Journal of Clinical Psychology*, 39(4), 349-362.
- Black, D., Morris, J. N., Smith, C., & Townsend, P. (1982). *Inequalities in health: The Black report*. London: Department of Health and Social Security.
- Black, S. A., Jakobi, P. L., Rush, R. D., et al (1999a). "Ethnic variation in the health burden of self-reported diabetes in adults aged 75 and older." *Ethnic Disparities*, 9(1):22-32.
- Black, S. A., Ray, L. A., & Markides, K. S. (1999b). "The prevalence and health burden of self-reported diabetes in older Hispanic established populations for epidemiologic studies of the elderly." *American Journal of Public Health*, 89(4), 546-552.
- Boyle, J. P., Honeycutt, A. A., Narayan, K. M., Hoerger, T. J., Geiss, L. S., Chen, H., et al. (2001). "Projection of diabetes burden through 2050: Impact of changing demography and disease prevalence in the U.S." *Diabetes Care*, 24, 1936-40.
- Bradley, C. J., Given, C. W., & Roberts, C. (2002). "Race, socioeconomic status, and breast cancer treatment and survival." *Journal of the National Cancer Institute*, 94(7), 490-496.
- Browning, C. R., Cagney, K. A., & Wen, M. (2003). "Explaining variation in health status across space and time: Implications for racial and ethnic disparities in self-rated health." *Social Science & Medicine*, 57, 1221-1235.
- Centers for Disease Control and Prevention (2003). "Diabetes surveillance system." Atlanta, GA: U.S. Department of Health and Human Services. Accessed at <http://www.cdc.gov/diabetes/statistics/index.htm> on 28 October 2006.
- Connolly, V., Unwin, N., Sherriff, P., Bilous, R., & Kelly, W. (2000). "Diabetes prevalence and socioeconomic status: A population based study showing prevalence of type 2 diabetes mellitus in deprived areas." *Journal of Epidemiology and Community Health*, 54(3), 173-177.
- Dannefer, D. (2003). "Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory." *Journal of Gerontology*, 58B(6), S327-S337.
- Dannefer, D. (1987). "Aging as intra-cohort differentiation: Accentuation, the Matthew effect, and the life course." *Sociological Forum*, 2, 211-236.
- Davey Smith, G., Harding, S., Rosato, M. (2000). "Relation between infants' birthweight and mothers' mortality: Prospective observational study." *BMJ*, 320, 839-40.

- Dayal, H. H., Power, R. N., & Chiu, C. (1982). –Race and socio-economic status in survival from breast cancer.” *Journal of Chronic Disease*, 35(8), 675-683.
- Elder, G. H. (1985). –Perspectives on the life course.” In G. H. Elder (Ed.), *Life course dynamics* (pp. 23-49). Ithaca, NY: Cornell University Press.
- Eriksson, J. G., Forsen, T., Tuomilehto, J., et al. (2001). –Early growth and coronary heart disease in later life: Longitudinal study.” *BMJ*, 322, 949-53.
- Escarce, J. J., Morales, L. S., & Rumbaut, R. G. (2006). –The health status and health behaviors of Hispanics.” In M. Tienda & F. Mitchell (Eds.) *Hispanics and the Future of America*. Washington, DC: The National Academies Press. Pp. 362-409.
- Farmer, M. M., & Ferraro, K. F. (2005). –Are racial disparities in health conditional on socioeconomic status?” *Social Science & Medicine*, 60, 191-204.
- Ferraro, K., Farmer, M. M., & Wybraniec, J. A. (1997). –Health trajectories: Long-term dynamics among Black and White adults.” *Journal of Health and Social Behavior*, 38, 38-54.
- Ferraro, K. F., Thorpe, R. J., McCabe, G. P., Kelley-Moore, J. A. Jiang, Z. (2006). –The color of hospitalization over the adult life course: Cumulative disadvantage in Black and White?” *The Journal of Gerontology*, 61(6), S299-306.
- Forouhi, N., Hall, E., & McKeigue, P. (2004). –A life course approach to diabetes.” In D.L. Kuh & Y. Ben-Shlomo (2nd ed.) *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life*. Oxford: Oxford University Press, 165-188.
- Gabe, J., Bury, M., & Elston, M. A. (2004). *Key concepts in medical sociology*. London: Sage Publications.
- Gillman, M. W. (2004). A life course approach to obesity. In D.L. Kuh & Y. Ben-Shlomo (2nd ed.) *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life*. Oxford: Oxford University Press, 189-217.
- Haas, S. (2008). –Trajectories of functional health: The ‘long arm’ of childhood health and socioeconomic factors.” *Social Science & Medicine*, 66(4), 849-861.
- Halfon, N., & Hochstein, M. (2002). Life course health development: An integrated framework for developing health, policy, and research.” *Milbank Quarterly*, 80, 433.
- Haris, M., Eastman, R. C., Cowie, C. C., Flegal, K. M., & Eberhardt, M. D. (1999) –Racial and ethnic differences in glycemic control of adults with type 2 diabetes.” *Diabetes Care*, 22(3), 403-408.

- Hayward, M. D., Miles, T. P., Crimmins, E. M., & Yang, Y. (2000). –The significance of socioeconomic status in explaining the racial gap in chronic health conditions.” *American Sociological Review*, 55(6), 910-930.
- Health and Retirement Study (2008). Public use dataset. Produced and distributed by the University of Michigan with funding from the National Institute on Aging (grant number NIA U01AG009740). Ann Arbor, MI.
- Heisler, M., Faul, J. D., Hayward, R. A., Langa, K. M., Blaum, C., & Weir, D. (2007). –Mechanisms for racial and ethnic disparities in glycemic control in middle-aged and older americans in the Health and Retirement Study.” *Archives of Internal Medicine*, 167(17), 1853-1860.
- Heiss, F., Hurd, M. D., & Borsch-Supan, A. (2003). –Healthy, wealthy, and knowing where to live: Trajectories of health, wealth, and living arrangements among the oldest old.” NBER Working Paper No. 9897
- House, J. S. (2002). –Understanding social factors and inequalities in health: 20th century progress and 21st century prospects. *Journal of Health and Social Behavior*, 43, 125-142.
- House, J. S., Lepkowski, J. M., Kineey, A. M., Mero, R. P., Kessler, R. C., Y Herzog, R. A. (1994). –The social stratification of aging and health.” *Journal of Health and Social Behavior*, 35, 213-34.
- House, J. S., Lantz, P. M., & Herd, P. (2005). –Continuity and change in the social stratification of aging and health over the life course: Evidence from a nationally representative longitudinal study from 1986 to 2001/2002 (Americans‘ Changing Lives Study) .” *Psychological Sciences and Social Sciences*, 60, S15-S26.
- Howard, G., Anderson, R. T., Russell, G., Howard, V. J., & Burke, G. L. (2000). –Race, socioeconomic status, and cause-specific mortality.” *Annals of Epidemiology*, 10(4), 214-23.
- Idler, E. L., & Benyamini, Y. (1997). –Self-rated health and mortality: A review of twenty-seven community studies.” *Journal of Health and Social Behavior*, 38(1), 21-37.
- Kapteyn, A., Michaud, P., Smith, J., & Soest, A. V. (2006). –Effects of attrition and non-response in the Health and Retirement Study.” *Working Papers 407*, RAND Corporation Publications Department.
- Kahn, J. R., & Pearlin, L. I. (2006). –Financial strain over the life course and health among older adults.” *Journal of Health and Social Behavior*, 47, 17-31.
- Keeler, E. B. (1992). Effects of cost sharing on use of kmedical services and health.” *Journal of Medical Practice Management*, 8, 317-321.

- Kelley-Moore, J. A., & Ferraro, K. F. (2004). "The Black/White disability gap: Persistent inequality later in life?" *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 59: S34-S43.
- Kennedy, B. P., Kawachi, I., Glass, R., & Prothrow-Stith, D. (1998). "Income distribution, socioeconomic status, and self-rated health in the United States: Multilevel analysis." *British Medical Journal*, 317(7163), 917-921.
- Kingston, R. S., & Smith, J. P. (1997). "Socioeconomic status and racial and ethnic differences in functional status associated with chronic diseases." *American Journal of Public Health*, 87(5), 805-810.
- Kuh, D., & Ben-Schlomo, Y. (2004). *A Life Course Approach to Chronic Disease Epidemiology; Tracing the Origins of Ill-health from Early to Adult Life* (2nd ed.). Oxford: Oxford University Press.
- Lamont, D., Parker, L., White, M. *et al.* (2000). "Risk of cardiovascular disease measured by carotid intima-media thickness at age 49-51: Lifecourse Study." *BMJ*, 320, 273-78.
- Lannin, D. R., Mathews, H. F., Mitchell, J., Swanson, M. S., Swanson, F. H., & Edwards, M. S. (1998). "Influence of socioeconomic and cultural factors on racial differences in late-stage presentation of breast cancer." *JAMA*, 279, 1801-1807.
- Law, C. M., Shiell, A. W., Newsome, C. A., et al. (2002). "Fetal, infant, and childhood growth and adult blood pressure: A longitudinal study from birth to 22 years of age." *Circulation*, 105(9), 1088-92.
- Liang, J., Quinones, A. R., Bennett, J. M., Ye, W., Xu, X., Shaw, B. A., & Ofstedal, M. B. (2010). "Evolving self-rated health in middle and old age: How does it differ across Black, Hispanic, and White Americans?" *Journal of Aging and Health*, 22(3), 3-26
- Liang, J., Xu, X., Bennett, J. M., Ye, W., & Quinones, A. R. (in press). "Ethnicity and changing functional status in middle and late life: A person-centered approach." *Journal of Gerontology: Social Sciences*.
- Link, B. G., & Phelan, J. (1995). "Social conditions as fundamental causes of disease." *Journal of Health and Social Behavior*, 35 (extra issue), 80-94.
- Lutfey, K., & Freese, J. (2005). "Toward some fundamentals of fundamental causality: Socioeconomic status and health in the routine clinic visit for diabetes." *American Journal of Sociology*, 110(5), 1326-72.
- Lynch, S. M. (2003). "Cohort and life-course patterns in the relationship between education and health: A hierarchical approach." *Demography*, 40(2), 309-331.
- McDonough, P., & Berglund, P. (2003). "Histories of poverty and self-rated health trajectories." *Journal of Health and Social Behavior*, 44(2), 198-214.

- McDonough, P., Sacker, A., & Wiggins, R. D. (2005). –Time on my side? Life course trajectories of poverty and health.” *Social Science and Medicine*, *61*, 1795-1808.
- Merton, R. K. (1988). –The Matthew effect in science, II: Cumulative advantage and the symbolism of intellectual property.” *ISIS*, *79*, 606-623.
- Miller, T. R., & Wolinsky, F. D. (2007). –Self-rated health trajectories and mortality among older adults.” *Journal of Gerontology*, *62*(1), S22-7.
- Narayan, K. M., Boyle, J. P., Thompson, T. J., Sorenson, S. W., & Williamson, D. F. (2001). –Lifetime risk for diabetes mellitus in the United States.” *JAMA*, *290* 1884-1890.
- Nazroo, J. Y. (2003). –The structuring of ethnic inequalities in health: Economic position, racial discrimination, and racism.” *American Journal of Public Health*, *93*(2), 277-284.
- Parchman, M. L., Pugh, J. A., Noel, P. H., & Larme, A. C. (2002). –Continuity of care, self-management behaviors, and glucose control in patients with type 2 diabetes.” *Medical Care*, *40*(2), 137-144.
- Phelan, J. C., Link, B. G., Diez Roux, A., Kawachi, I., & Levin, B. (2004). –Fundamental causes” of social inequalities in mortality: A test of the theory.” *Journal of Health and Social Behavior*, *45*(3), 254-285.
- Pearlin, L. I., Schieman, S., Fazio, E. M., & Meersman, S. C. (2005). –Stress, health, and the life course: Some conceptual perspectives.” *Journal of Health and Social Behavior*, *46*(2), 205-219.
- Peek, C. W., Coward, R. T., Henretta, J. C., Duncan, R. P., & Dougherty, M. C. (1997). –Differences by race in the decline of health over time.” *Journal of Gerontology*, *52B*(6), S336-S334.
- Rabe-Hesketh, S., & Skrondal, A. (2005). *Multilevel and Longitudinal modeling using Stata*. College Station, TX: Stata Press.
- RAND. (February 2008). HRS Data, Version H. Produced by the RAND Center for the Study of Aging, with funding from the National Institute on Aging and the Social Security Administration. Santa Monica, CA
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and data analysis methods* (2nd Edition). Thousand Oaks, CA: Sage.
- Robbins, J. M., Vaccarino, V., Zhang, H., & Kasl, S. V. (2001). –Socioeconomic status and type 2 diabetes in African American and non-Hispanic white women and men: Evidence from the Third National Health and Nutrition Examination Survey.” *American Journal of Public Health*, *91*(1), 76-83.
- Robert, S. A., & Lee, K. Y. (2002). –Explaining race differences in health among older adults.” *Research on Aging*, *24*(6), 654-683.

- Schulz, A. J., Williams, D. R., Israel, B. A., & Lempert, L. B. (2002). –Racial and spatial relations as fundamental determinants of health in Detroit.” *The Milbank Quarterly*, 80(4), 677-707.
- Shuey, K. M., & Willson, A. E. (2008). –Cumulative disadvantage and Black-White disparities in life-course health trajectories.” *Research on Aging*, 30, 200-225.
- Smedley, B. D., Stith, A. Y., & Nelson, A. R., Eds. (2003). *Unequal treatment: Confronting racial and ethnic disparities in Health Care*. Washington, DC: National Academies Press.
- Strohschein, L. (2005). –Household income histories and child mental health trajectories.” *Journal of Health and Social Behavior*, 46(4), 359.
- Van Ryn, M., & Fu, S. S. (2003). Paved with good intentions: Do public health and human service providers contribute to Racial/Ethnic disparities in health? ” *American Journal of Public Health*, 93(2), 248-255.
- Wilkinson, R. G. (1996). *Unhealthy societies: The afflictions of inequality*. New York: Routledge.
- Williams, D. R. (1999). –Race, socioeconomic status, and health: The added effects of racism and discrimination. In N. Adler, M. Marmot, B. McEwen, & J. Stewart (Eds.) *Socioeconomic status and health in industrialized nations: Social, psychological, and biological pathways*. ” *Annals of the New York Academy of Sciences*, 896, 173-188. New York: New York Academy of Sciences.
- Williams, D. R. (1997). –Race and health: Basic questions, emerging directions. ” *Annals of Epidemiology*, 7(5), 322-333.
- Williams, D. R., & Collins, C. (2001). –Racial residential segregation: A fundamental cause of racial disparities in health. ” *Public Health Reports*, 116(5), 404-416.
- Willson, A. E., Shuey, K. M., & Elder, G. H. (2007). –Cumulative advantage processes as mechanisms of inequality in life course health. ” *American Journal of Sociology*, 112(6), 1886-1924.
- Wolinsky, F. D., & Tierney, W. M. (1998). –Self-rated health and adverse health outcomes: An exploration and refinement of the trajectory hypothesis. ” *Journal of Gerontology*, 53B(6), S336-S340.
- Wyatt, S. B., Williams, D. R., Calvin, R., Henderson, F. C., Walker, E. R., & Winters, K. (2003). –Racism and cardiovascular disease in African Americans.” *The American Journal of the Medical Sciences*, 325(6), 315-331.

Chapter 4

Gender, Health Behaviors, and the Paradox of Social Ties: A Mixed-Method Examination of Functional Decline among Mid- and Late-Life Diabetics

Abstract

Men and women experience pronounced differences in functional decline as they age. The mechanisms behind these differences are not understood, particularly in chronically ill populations. This research examines gender differences in functional decline, focusing on two mechanisms suggested by the literature to partially mediate these disparities, health and illness behaviors and social ties.

A mixed-method analysis was used for this study. Health and Retirement Study (HRS) data on individuals aged 50 and older with type 2 diabetes mellitus (n= 2,493) were used to examine change in functional status over a 10-year period using multi-level models. These data were supplemented with interviews from a primary data collection of 30 community-dwelling adults with type 2 diabetes in the greater Detroit region. Health and illness behavior measures included doctor visits, home care, rating of doctor's performance, weight level, smoking and drinking status, and frequency of vigorous physical activity. Social tie measures included partnership status, receipt of informal care and support for adhering to a regimen, the respondent's level of disability relative to one's partner's, and the number of surviving family members (including parents, siblings, and children).

Women and men both experienced functional decline over time. In the models that examined functional limitations and covariates over time, added health and illness behavior measures, and added social tie characteristics, women experienced sharper rates of functional decline than men. The exception was in the final model, which examined functional decline, covariates, health and illness behaviors, and social ties together. In this final model, men experience a sharper rate of decline relative to women. Through the analysis of quantitative and qualitative data, it appears that it is the interaction of health and social characteristics (largely through engagement in socially supportive that promote health) that are protective against health decline.

The qualitative data illustrate the findings that social ties interact strongly with health in the prediction of functional decline. These patterns differ strongly by gender, contributing to previous research on gendered behaviors in health and social behavior. The interaction between these characteristics unveiled in this mixed-method research that offers new insight into opportunities to maximize health among chronically ill populations through gender- appropriate interventions.

Introduction

For decades, researchers have investigated gender differences in health and have suggested mechanisms to explain them (Enterline, 1961; Madigan, 1957; Nathanson, 1977; Verbrugge, 1975). However, social and epidemiological research aiming to find gender differences in outcomes is challenged by the countless social and health determinants to which men and women are differently exposed over the life-course. This study will investigate gender differences in long-term functional status among adults with diabetes in middle age and late life. Despite consistent gender differences in disability outcomes, the mechanisms underlying different outcomes over time are not clear. The broad question of inquiry guiding this research is how gendered experiences shape longitudinal health outcomes in mid- and late life. Using the life course perspective this study will test two common explanations for differences in health and disablement processes and outcomes by gender—health and illness behaviors and social ties.

This study is unique in that these explanations will be tested to allow mechanisms to change longitudinally (using a random slope, random intercept longitudinal multi-level model). This method allows for an enhanced analysis of temporal precedence between predictors and outcome variables as well as time-varying covariates. Quantitative research, however, cannot fully disentangle the influences of lived experiences on subsequent health outcomes. Qualitative data can improve the understanding of chronic illness within the greater context of individuals' lives. More precisely, the triangulation of qualitative data with quantitative data can provide texture, explanations of significant or non-significant findings, and greater detail about the mechanisms through which measures interact. The mixed-method approach is therefore used to further illustrate the

processes identified as significant, non-significant, or changing relationships in this study.

Background

In general, studies have found higher rates of mortality among men and higher rates of disability among women (Gorman & Read, 2006; Lubitz et al., 2003; Merrill et al., 19978; Newman & Brach, 2001; Wingard et al., 1989; Verbrugge 1985). As a group, women have reported more functional limitations in all age categories, reporting 2.3 Activity of Daily Living (ADL) and Instrumental Activity of Daily Living (IADL) limitations, compared to 1.6 limitations for men, with 23% of women (age-adjusted) reporting ADL limitations and 31% of women reporting IADL limitations, compared to 17% and 15% for men respectively (Spitze & Logan, 1989). The gender gap also increases with age, even into the elderly years (Gorman & Read, 2006; Liang et al., 2008; Marks 1996; Merrill et al., 1997; Newman & Branch, 2001). Women's disproportionate burden of disability over the life course is a great concern, particularly for older chronically ill populations who might require extensive self-care to manage their illnesses.

Studies focusing on gender differences in chronic illness outcomes in mid- and late-life have had been less clear cut than those focusing on the general population. In the general population, it has been established that men have higher levels of initial life-threatening chronic diseases and mortality and lower levels of non-threatening chronic disease morbidity relative to women (referred to as the "iceberg of morbidity" (Verbrugge & Wingard, 1987). Less is known, however, about gender differences (and

mechanisms behind them) in health and disability status among populations who are already chronically ill. In a longitudinal analysis of National Health and Nutritional Examination Surveys, the mortality gap between diabetic men and women narrowed over the last three decades: the mortality rate for all causes among diabetic men decreased by 18.2 deaths per 1000 persons (from 42.6 in 1971 to 24.4 annual deaths per 1000 in 2007), accompanying mortality decreases in the population overall, while diabetic women did not experience a decline in the all-cause mortality rate (Gregg et al 2007). In another study focusing on health decline among type 2 diabetics aged 60 and older, no significant difference was found between men and women in the probability of health status decline when illness support, health and illness behaviors, and other disease and socioeconomic factors were controlled (Nicklett & Liang 2010). The inconsistencies in the findings could relate to different measurement issues. For example, many studies do not take differential mortality into consideration, as men are more likely to die from a chronic illness than women. Further, most studies are cross-sectional and therefore are not able to prospectively examine long-term outcomes. While it has been established that functional decline is much more rapid among chronically ill populations such as diabetics (Wu et al., 2003), little is known about how and why men and women differ in these processes. This research addresses this gap by examining longitudinal differences in the mechanisms related to functional decline of diabetics over time for men and women. Further, the triangulation of the qualitative data with the quantitative data provides more information about the processes through which men and women confront different risk factors over the life course.

Previous studies suggest that men and women experience pronounced differences in functional status and these differences grow as populations age (Gorman & Read, 2006), but the mechanisms are not clearly understood. Perhaps gender disparities in health and disability outcomes are difficult to capture in this case because risk exposure varies by kind of risk, subgroup, and stage of the life course. The cumulative effects of social disadvantage both men and women experience at different life course stages could lead to contradictory results. Gender differences in functional status and other health outcomes are a product of differential exposure to health insults by gender over the life course. The advantage of this study is that differences in gendered exposures to risk and protective factors will be examined over a 10-year period, which enables time-varying explanatory, dependent, and covariate measures to vary over time. In addition, this study utilizes qualitative data to investigate the circumstances and characteristics that highlight cases in which the quantitative findings were either supported or refuted, providing more information about what mechanisms underlie gendered differences in functional decline among chronically ill populations—and how these mechanisms change over the time.

Hypotheses & Conceptual Framework

Four hypotheses will be tested in this analysis:

Hypothesis 1:

- Women will have more rapid rates of functional decline relative to men (controlling for socio-demographic characteristics but not controlling for health and illness behaviors or social ties)

Hypothesis 2:

- Health and illness behaviors that are beneficial (such as engaging in physical activity, keeping weight under control, and adhering to a regimen) will be negatively associated with functional decline over time for both men and women;
- Risky health and illness behaviors (such as smoking, alcohol consumption, obesity, and non-adherence) will be positively associated with functional decline over time for both men and women;
- Due to women's engagement in more health-promoting behaviors (and avoidance of more insults to health), health and illness behaviors will mediate functional decline for women and men, but more so for women.

Hypothesis 3:

- The receipt of positive forms of social support is negatively associated with functional decline over time, such as receipt of informal care, support for adherence, supportive relationships, and broader social networks.
- The provision of tangible support (through informal caregiving and other social obligations) is positively associated with functional decline over time.
- As women tend to be more deeply engaged in social ties than do men, the positive aspects and the negative aspects of social ties will more strongly mediate functional decline for women than for men.

These hypotheses concerning the relationship between gender and functional decline—taking health and illness behavior and the paradox of social ties as mediators—are

embedded in life course theory, which recognizes the importance of historical time and place, timing of lives, linked or interdependent lives, and human agency on subsequent well-being or health/functional outcomes (Elder, 1998). Specifically of interest is the life-course exposure to risk and protective factors and how life experiences can alter these outcomes in individuals (Halfon & Hochstein, 2002). Although men fare far worse than women in health, women continue to confront structural disadvantages at work and home (Doyal, 1995).

Gendered Review of Mechanisms

Health and Illness Behaviors

In general, men and women are exposed to different risk factors, with men engaging in more risk-inducing and less health-promoting behavior than women (Courtenay, 2000; Goldberg, 1976; Waldron, 1988; Waldron & Johnston, 1976), which challenges the “surviving myth of masculine privilege” in health (Verbrugge, 1985). This is particularly a concern for chronically ill populations. Gender differences in health and illness behaviors can complicate the analysis of gender differences in long-term health or disability outcomes. For example, earlier-life health damaging behaviors are often excluded from analyses in cross sectional studies and positive health behaviors could have been adopted later in life in *response* to a life-threatening disease or as a chronic illness regimen. Thus, cross-sectional research cannot answer questions about the time order of the key variables. Cross-sectional methods also limit the researcher’s ability to disentangle many of the causal relationships by examining processes as they unfold. In this study, however, the predictors, dependent variables, and covariates are analyzed in a

time-lagged structure to enable the change of preceding changes in mechanisms (particularly in health and illness behaviors and social ties) on functional status by gender). Further, many longitudinal studies lack the complexity in the survey design to disentangle changing health behaviors and risk factors of the respondents over time. The majority of variables used in this analysis are time-varying, allowing changes over time to be observed in the prediction of longitudinal disability outcomes. Finally, even complex longitudinal designs lack the ability to illustrate some of the motivating factors that explain such behaviors as can qualitative research. For example, men's diets are less healthy and nutritious than are women's (Denke, Sempos, & Grundy, 1993; Oleckno & Blacconiere, 1990; Oppenheim, 1994; Shi, 1998; Walker et al., 1988; Weissfeld, Kirsch, & Brook, 1990), including less fiber, fewer vegetables, and less carotenoid-rich foods such as carrots, spinach, and broccoli (Foerster & Hudes, 1994; Leigh & Freis, 1993; McLelland et al., 1998; Nebeling et al., 1997; Prohaska et al., 1985; Serdula et al., 1995; Van Horn et al., 1991). Men also consume more cholesterol and saturated fat even controlling for body size (Shi, 1998; Van Horn et al., 1991), are less likely to limit fat or red meat than women, (Kann et al., 1998; Rakowski, 1986), and are more likely to eat high-fat foods in restaurants and convenience stores (Foerster & Hudes, 1994).

While most studies have found that men are more physically active than women (e.g. Dean, 1989), women's exercise patterns are relatively more health-promoting and sustainable relative to those of men (Dean, 1989; Walker et al., 1998; Weissfeld, Kirsch, & Brooke, 1990). Further, women have historically had more problems with being overweight and obese, but the gender differences appear to be leveling off (Ogden et al., 2006). Substance use is also associated with higher prevalence and worse outcomes for

chronic diseases such as diabetes, and men use alcohol and tobacco more frequently than women and at younger ages (Dean, 1989; Harrell et al., 1998; Kann et al., 1998; Pascale & Evans, 1993; Kessler et al., 1994; Robins et al., 1984). Gender differences in substance use, diet and different kinds of physical activity—all strongly linked to the onset and control of chronic illnesses such as diabetes—could explain the high mortality rates among the male population (Galuska et al., 1996).

Women and men also differ in health care utilization, with men generally utilizing fewer health services, even controlling for reproductive and gender-specific conditions (Courtenay 2000). Although women are more likely to seek preventative care, extensive has documented gender disparities in the amount of care men and women receive: physician screening and treatment practices for chronic illnesses (particularly for cardiovascular disease and diabetes) that are more rigorous for men in clinical settings (Bird et al., 2007; Chou et al., 2007; Correa-de-Araujo et al., 2006; Lucas et al., 2006; Rathore et al., 2000; Wexler et al., 2005; Vacarrino et al., 2001). A recent study by Tabenken and colleagues (2004) found that time is allocated differently for men and women during outpatient visits, with a higher proportion of time spent on procedures and health behavior counseling for men (relative to omen) and that more eligible men than women received exercise, diet, and substance abuse counseling. In sum, women generally seek preventive care to a greater extent than men; however, research suggests that chronic care interventions and treatment is less suited to manage and control chronic diseases for women, due largely to practitioners' lack of understanding of chronic disease patterns among women. Gendered differences in health behavior and differences in the processes through which men and women seek and utilize care should not be evaluated in a

vacuum. Instead, there are social factors that independently influence functional status and that interact with health and illness behavior to predict functional decline over time.

Social Ties

The association between social relationships and health/longevity has long been recognized in the literature, and there is compelling evidence that this can be extended to chronically ill populations (Glass et al., 2000; Schulz et al., 2006; Uchino, 2004; Wills & Filer, 2001). Support has been found to be protective against mortality, health/functional decline, and cognitive aging in community and population-based studies of chronically ill older adults (Berkman, 2000; Eng et al., 2002; Seeman, 1996; Seeman et al., 2001). Unfortunately, it is difficult to disentangle the relative effects of social support, networks, social ties, integration (Berkman et al., 2000), which are so often used interchangeably in the literature. The ties of marriage and family has also been found to be positively associated with health, largely due to support, the deterrence of negative health behaviors and the adoption of positive health behaviors—particularly for men (Schoene & Weinick, 1998; Umberson, 1987). Social ties—and the relative weight of these different ties on health outcomes—differs by gender: women are more likely to have more social ties than men and to rely on multiple sources of emotional support (Belle, 1987; Broadhead et al., 1983; Burda, Vaux, & Schill, 1984; Fischer & Oliner, 1983; Fuhrer & Stansfeld, 2002; Kandrack, Grant, & Segall, 1991; Verbrugge, 1985). In contrast, men are more likely to name their spouse as the “closest person” in their social network (Fuhrer & Stansfeld, 2002). Given that men mobilize more homogenous supports than women in times of need or stress, lack of social ties or social support in times of need could be a health risk factor for men (Belle 1987; Berkman 1984; Berkman & Breslow, 1983; Blazer, 1982; House,

Landis, & Umberson, 1988; House, Robbins, & Metzner, 1982; Schoenbach et al., 1986; Seeman et al., 1987; Shye et al., 1995; Umberson 1992).

In addition to general social support, social ties can be beneficial to chronically ill individuals. Social ties are excellent mechanisms to share health-related information (Kang et al., 1994; Marshall, Smith & McKeon, 1995), handle feelings associated with chronic illnesses (Roberts et al., 1994 ; Spiegel et al., 1989), and promote illness self-management (Gallant, 2003; Nicklett & Liang, 2010). Those with more social support are more likely to modify unhealthy behavior (Gruninger, 1995), to adhere to medical treatment (Meichenbaum & Turk, 1987; O'Brien, Petrie, & Raeburn, 1992), and to engage in more positive healthier behaviors and practices overall (Bovbjerg et al., 1995; Cwikel et al., 1998; Lonquist, Weiss, & Larsen, 1992; Schoene & Weinick, 1998).

Despite these benefits, social ties and social relationships can also bring responsibility and strain, which is unequally distributed in society by race/ethnicity and by and socioeconomic status and class (Weiss et al., 2005; Pirraglia et al., 2005; Savage & Bailey, 2004). This is particularly salient through the extensive process of providing informal care to individuals with chronic illnesses such as diabetes (Langa et al., 2002). Additional studies examining spousal caregivers have found lower affect and increased depression among spousal caregivers than among other friends or family members (Schofield et al., 1998; Schultz et al., 1995), which can feedback into potential harmful caregiving situations as well (Beach et al., 2005). However, the cumbersome process of providing care to a chronically ill person can be improved with higher levels of intimacy and love and has in some cases been found to be beneficial or therapeutic to the caregiver (Braithwaite, 2000; Charmaz, 1993).

Studies have generally found that caregiving responsibilities and strain are particularly felt by women (Frankenhaeuser et al., 1989). Other studies, however, found that while women were more likely to become informal caregivers, caregiver burden and strain differed little by gender once one became a caregiver (Miller, 1990; Pinquart & Sorensen, 2006). When assessing the long-term health outcomes of chronically ill populations, therefore, social ties can be paradoxical: certain aspects of social ties (such as social support, density of ties, receiving care and illness support, and supportive partnerships) seem to positively affect health, while other aspects of social ties (such as caregiving, conflictual relationships, and other forms of strain) seem to negatively affect health. Social ties have been found to be an asset particularly for women in managing social and medical aspects of chronic illnesses. Like health and illness behavior, the impact of social ties on functional change is best evaluated using longitudinal data. Here, change in functional status will be observed over a 10-year period, enabling most social ties to vary over time to better establish temporal precedence. In addition, the triangulation of qualitative and quantitative data reveals the nuanced benefits and drawbacks of social ties by gender, other social characteristics, and at different stages in mid- and late-life.

Methods

Quantitative and qualitative data are used to analyze gender differences in functional status and the role of mediating factors (health and illness behaviors and social ties) in narrowing or widening these gender disparities. The qualitative data supplement

the findings quantitative data and provide explanation and illustration of significant or non-significant findings. Here, the quantitative and qualitative samples used in the study will be briefly discussed. Descriptive statistics are provided for the quantitative sample. Finally, the methodological procedures are described for the quantitative and the qualitative analyses.

Sample

Multiple data sources are examined in this analysis, including the longitudinal Health and Retirement Study (HRS) data, the 2003 HRS Diabetes Study, and primary data collected in the greater Detroit region. Longitudinal data (collected biennially over a 10-year period) are drawn from the HRS using the RAND (2010) combined data files and imputations. HRS is a national, population-based study that has tracked individuals and households since 1992. Adjusting for mortality, HRS has maintained a response rate over 80% in all biennial waves. The 2003 Diabetes Supplement fielded 2,391 cases who (a) reported having diabetes in HRS 2002 and (b) were eligible for supplemental examination. Surveys were returned by 1,901—approximately 80%—of the eligible pool. The mailed survey requested diabetes-specific information and had more general questions regarding health, illness, and utilization of care. Data are linked with the larger HRS sample with person-level identifiers. The HRS and the 2003 Diabetes study are conducted by the University of Michigan (Survey Research Center) and are funded by the National Institute of Aging (NIA U01AG009740).

Thirty diabetics of middle- and late age were recruited from the greater Detroit region through the Research Participant Program at the Geriatric Center at the University

of Michigan (which links patients involved through the Institute of Gerontology to research studies). As the Institute of Gerontology maintains socio-demographic and health information on the subject pool, the problem of sampling bias in this community was addressed by stratifying to promote geographic, ethnic, gender, and socioeconomic heterogeneity. Data collection took place from May to July 2008. Three potential respondents were unwilling to participate, two were out of geographical scope, and two were unable due to current hospitalization. Respondents completed a brief survey instrument (addressing comorbidities, diabetes-specific data, and socio-demographic information), an even history calendar of life and health events, and engaged in recorded semi-structured interviews.

Analytic Sample

The analytic sample consists of 2,493 adults aged 50-103 who participated in the 1998 HRS wave and at least 2 follow up waves who either reported having type 2 diabetes at baseline or reported developing type 2 diabetes during the 10-year follow-up observation period (1998-2008). Observations are in person-year in longitudinal multi-level analysis; therefore, the analytic sample includes 18,572 observations from the 5 biennial waves.

Among cross-wave pooled survey responses, the majority of respondents (73%) were non-Hispanic White, while 16% were non-Hispanic Black, 9% were Hispanic/Latino, and 2% reported being of another race/ethnicity. Approximately one-third reported having completed high school / GED, one third less than high school, and one third greater than high school (18% with some college and 15% with completion of

college). About 32% of observations are currently working (37% of males and 25% of females). The average age at baseline is 67 and the average year of diabetes diagnosis is 1994. On average, respondents reported one (1.097) functional or instrumental impairment and no variables were correlated at a value greater than the absolute value of 0.28.

The community sample lived within 60 miles of Detroit in cities and towns of diverse population densities, socio-demographic compositions, crime levels, and programs for senior citizens. The age of participants ranged from 51-92 years of age, with a wide range of physical functionality. Participants' experience with diagnosed diabetes ranged from 1-40 years. There were 13 men and 17 women in the sample.

Measure

The dependent variable is functional status for each data collection year, which is measured through a constructed variable combining any difficulty in performing Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) in each of the 6 waves. ADLs include difficulty walking across a room, getting in and out of bed, dressing, bathing, and eating. IADLs include using the phone, managing money, and taking medications. The year-varying values range from 0-8, with 0 meaning difficulty performing no tasks and 8 meaning some difficulty in performing all tasks. Change in functional status is suggested if the coefficient is a statistically significant value that is either positive (suggesting functional decline over a 10-year period) or negative (suggesting functional improvement over a 10-year period).

Gender is a dichotomous time invariant measure. The explanatory measures of health and illness behavior were selected based upon previous literature for relevance to the diabetes regimen and subsequent outcomes for functional status for both men and women (and were, of course, limited based on availability of the data). The variables to measure health and illness behavior include: (a.) number of doctor's visit's in the last 2 years (time-varying and top-coded at 52 visits over a period of 2 years); (b.) whether or not the respondent receives home health care (time-varying); (c.) degree satisfaction with provider management of care (Overall, what grade would you give your doctors, nurses, or other health care providers for how well they helped you manage your diabetes in the past six months? A+ to F), from the 2003 Diabetes Survey (time-invariant); (d.) a categorical weight level variable constructed according to BMI thresholds, including underweight, right weight, overweight, and obese (time-varying); (e.) whether or not they currently smoke (time-varying); (f.) whether or not they currently drink alcohol (time-varying); (g.) whether or not they currently engage in physical activity 2-3 days or more per week (time-varying).

The explanatory measures of social ties were selected to capture different aspects of social ties (social support, tangible support, social ties, provision of care) that have been found to be protective against decline for both men and women in previous literature. Variables to measure social ties include: (a.) whether or not the respondent is currently married or partnered (time-varying); (b.) a dichotomous variable indicating whether or not the respondent received informal care for diabetes. This variable was operationalized by asking whether or not the respondent identified a spouse, other family member, or friend (in contrast to a paid caregiver or nobody) as handling most of their

diabetes care on their response to the 2003 Diabetes Survey (time-invariant); (c.) a composite scale (1-40) variable measuring the extent to which the respondent reports they can rely on family or friends to provide disease-related support on a variety of adherence dimensions, based on their responses to the 2003 Diabetes Survey (time-invariant); (d.) a measure of disability relative to one's spouse, which is a categorical variable comparing the respondent's ADL/IADL levels to that of their spouse or partner, if applicable, indicating if they are better, worse, or the same (time-varying); and (e.) categorical variables of the number of family members still living (time-varying), including parents (0-2), siblings (0, 1, 2, 3, or 4+), and children (0, 1, 2, 3, 4+).

Control variables were included to capture a number of relationships found to influence health outcomes among chronically ill older adult populations and that are often suggested as explanations of gender difference in health. Covariates included (a.) self-reported race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic/Latino, and other) and (b.) highest level of education achieved (less than high school, high school/GED, some college, and college or more), which were both time-invariant. Additional control variables include (c.) whether or not the respondent was currently working for pay, regardless of whether this is part-or full-time (time-varying), (d.) household assets (minus debts) per year (time-varying); (e.) the number of chronic conditions in a given wave, including high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis (time-varying), (f.) the age at baseline or 1998 (time invariant), the Center for Epidemiologic Studies Depression (CESD) scale (time-varying), and (g.) the year the respondent reports they were diagnosed with diabetes (time invariant). RAND imputed missing income data (RAND,

2009) and adjusted for slight variations in questions across waves. Given the nature of the model, subjects are not dropped from the analysis due to subsequent mortality or due to item non-response. Respondents who did not participate in the 2003 Diabetes Supplement were not dropped from the analysis; but their responses on supplement-specific time-invariant questions could not be incorporated into the model. Longitudinal multi-level models enable individuals to be followed over time who have unequal numbers of measurements or who are present at different time periods in a longitudinal study: all observations are used that are available for a given respondent in the analysis (West et al., 2007). The models are carried out under the assumption that data are missing at random. The final model was re-run using imputation for item missing data; however, the final results did not differ significantly from those presented.

Semi-structured interviews included questions regarding overall health and getting diabetes (including general health prior to diabetes diagnosis and initial experiences upon finding out they were diabetic), adherence (including what might help or hinder management), experiences with the healthcare system (including relationships with different providers and perceived quality of care), and social ties (forms of informal care and other support—provided and received). Interviews were transcribed and independently coded according to categorical themes and subthemes by two coders who then met to reach consensus. Coders did not participate as interviewers in the same interviews they coded. Coders were also reminded to code a phenomenon regardless of whether it was absent or present. General themes were developed according to Health Decision Model, including sociodemographic characteristics, socioeconomic situation, social interaction, experiences and outcomes, knowledge, health beliefs (general and

specific), and patient preferences (Eraker et al., 1984). Stress was included as a general theme due to empirical interest. Subthemes were initially suggested by a research team of the author and 5 other investigators then were revised in the initial coding process (e.g., for social interaction, subthemes include: (a.) general statements regarding social networks, (b.) general statements regarding civic/political engagement, (c. social interaction and networks specific to diabetes, (d.) receipt social support, informal care, caregiving; (e.) provision/giving of social support, informal care, caregiving). The final coded passages were entered into NVivo for qualitative analysis. These relevant coded passages were viewed following the quantitative data analysis and passages were coded that supported findings, refuted findings, or offered additional information or mechanisms not shown in the quantitative findings. Excerpts and summaries of quantitative findings were generated through this process.

Descriptive Statistics

Descriptive statistics – discussed at greater depth below – were computed for the measures of health and illness behavior, social ties, and all covariates. Means and standard deviations were computed separately for these variables for men and women in the pooled wave sample. Descriptive statistics are pooled—rather than presented at the respondent-level—to present data from the full sample (observations in person-years). See Table 4.1 and discussion below.

Table 4.1: Distribution of Sample Characteristics by Gender, 1992-2006

Sample: 2,493 Total: 18572	ADL / IADL					
	Male			Female		
	N	Mean	SD	N	Mean	SD
ADL/IADL	8458	0.75	1.62	10114	1.05	1.85
Race / Ethnicity						
Non-Hispanic White (ref)	29928	0.75	0.43	34488	0.72	0.45
Non-Hispanic Black	5742	0.14	0.35	8268	0.17	0.38
Hispanic	3252	0.08	0.27	4170	0.09	0.28
Other	882	0.02	0.15	1032	0.02	0.15
Education						
LTHS	16344	0.31	0.46	12162	0.34	0.47
HS / GED	17100	0.32	0.47	12702	0.36	0.48
Some College	8874	0.18	0.39	7200	0.19	0.39
College or More	5610	0.19	0.39	7680	0.12	0.32
Working Status (ref: working)	9779	0.37	0.48	8097	0.25	0.43
Mean Hhd Assets	26174	405676	1487342	32364	304363	1349736
Age at BL (above 50)	39852	67	10.36	47964	68.50	11.61
C-ESD	22123	1.38	1.83	29349	1.92	2.14
RCONDE	32362	2.14	1.51	26172	2.34	1.53
Year Diagnosed	10188	1993.91	10.01	12138	1994.16	10.38
Doc Visits in last 2 Yrs	39852	25.39	22.02	47964	26.08	21.60
Home care (ref: receiving)	25784	0.08	0.28	31373	0.11	0.31
Rate Doc's Performance	4950	2.91	1.98	5214	3.05	2.11
Weight Level						
Underweight	279	0.01	0.08	1153	0.02	0.15
Underweight	7070	0.18	0.38	10591	0.22	0.41
Overweight	18158	0.46	0.50	18391	0.38	0.49
Obese	14345	0.36	0.48	17829	0.37	0.48
Currently Smoking	23225	0.17	0.38	25844	0.16	0.37
Currently Drinking	26167	0.52	0.50	32356	0.33	0.47
Currently Vig Active (ref: 2-3+)	35970	0.26	0.44	43569	0.19	0.39
Partnership Status (ref: m/p)	26174	0.03	0.17	32364	0.02	0.13
Informal Care (ref: received 2003)	4878	0.82	0.38	5022	0.61	0.49
Support for Adherence (2003)	4488	23.05	6.24	4476	22.28	6.84
Disability Compared to Partner						
Better	2683	0.10	0.31	2683	0.06	0.23
Same	934	0.02	0.13	784	0.02	0.15
Worse	34753	0.87	0.33	44497	0.93	0.26
Living Family						
Parents	24743	0.21	0.47	31906	0.19	0.45
Siblings	39852	2.75	1.48	47964	2.70	1.52
Children	39852	3.19	1.16	47964	3.11	1.22

Table 4.1 shows the observations for respondents in the analysis across waves (unweighted). Women reported higher functional limitations than men (1.05 versus 0.75). The gender distribution was fairly even across race/ethnicity, but men were much more highly represented among respondents with at least a college level of education (19% versus 12%). Women were less likely to be working (25% versus 37%) and had fewer household assets than men (by about 100,000). The age distribution and year of diagnosis was similar by gender in the sample, but women had higher CESD values (1.38 versus 1.92) and a greater number of chronic illnesses (2.34 versus 2.14) than men.

The health and illness behavior measures were all significant predictors of functional status. Although women and men did not seem to differ in the frequency of physicians' visits, the percentage of women using home care was higher (11%) relative to men (8%). Women generally rated their doctor's performance in helping with management higher (3.05) than men (2.91). In the pooled sample, men and women were represented fairly evenly in the underweight and obese categories; however, a lower percentage of men relative to women (18% versus 22%) were underweight and a higher percentage of men relative to women (46% versus 36%) were overweight. Current smoking status did not differ by gender; however, men were much more likely to be current drinkers (52% versus 33%) and to engage in rigorous physical activity 2-3 times per week or more (26% versus 19%) relative to women.

Men and women reported similar levels of support from family or friends for adhering to their regimen, but a higher proportion of men reported receiving informal care for their diabetes (82% compared to 61% of women). The group sampled as a whole had far worse functional status than their partners/spouses not included in the sample:

men tended to have fewer functional limitations than their spouse/partners (10% of men had fewer ADL/IADL versus 6% of women), while women tended to have more functional limitations than their spouse/partners (87% of men had more ADL/IADL versus 93% of women). Men and women were almost equally likely to have no surviving parents, siblings, or children and had similar numbers of surviving family members. Through the comparisons of means, all social tie measures were significant predictors of ADL/IADL limitations in the pooled sample.

Analytic Strategy

The hypotheses are tested that these mechanisms operate differently (through health/illness processes as well as through social ties) by gender among chronically ill older adults. These hypotheses are tested through a series of models.

First, the hypotheses are tested separately for men and women through four multilevel models for each gender. The rationale for analyzing the data separately by gender (rather than simply using a gender indicator variable within the model) is to enable one to interpret the relationships between these mediating factors for both men and women. This will elucidate the relationships *between* hypotheses (and the corresponding measures) in relation to one another in Models 1-4, as these hypotheses are not competing but could operate in conjunction with one another.

Model 1 is the model longitudinal multi-level analysis of the covariates as predictors of functional status, excluding health and illness behavior and social tie variables. As with the other models, the analyses are separate for men and women. Model

2 includes the health and illness behavior measures and excludes social tie variables.

Model 3 includes the social ties variables and excludes the health and illness behavior characteristics. Finally, Model 4 includes the health and illness behavior variables, the social ties variables, as well as the covariates to examine the relationship of the mechanisms of these hypotheses when they are tested and modeled together.

Unfortunately, examining the models separately precludes significance tests. Therefore, two subsequent series of analyses test for significance in these models.

Second, Models 2-4 are adapted by including interaction variables of the covariates and health and illness behavior measures (Model 2), covariates and social tie measures (Model 3), and all measures (Model 4). The purpose of this series of 3 analyses is to test for significance in gender differences over time, which cannot be tested when examining models separately by gender.

Third, Models 1-4 are also run with gender added as a covariate. While these models are not shown, the results from these series of regressions enable significance tests of gender difference in functional decline for each of the four models individually, which also cannot be otherwise tested by examining results by gender separately.

Random intercept, random slope regression models test the hypothesis in a two-stage formulation. The reduced-form level-1 and level-2 models are written as:

$$y_{ij} = \gamma_{11} + \gamma_{21}x_{ij} + \beta_3x_{2ij} + \gamma_{12}w_j + \zeta_{1j} + \zeta_{2j}x_{2ij} - \epsilon_{ij}$$

$$y_{ij} = \beta_1 + \beta_2x_{ij} + \beta_3x_{2ij} + \beta_4w_j + \zeta_{1j} + \zeta_{2j}x_{ij} - \epsilon_{ij}$$

where y_{ij} is the functional status of the adult j at the given wave i , x_{ij} is the corresponding year (1992 = 0), and certain covariates are covariates only in the intercept equation (w_j --representing time-varying covariates in this analysis). As a total of eight models are used in this analysis (four men, four women), the entire equation of the model (with all variables) is not shown to obtain a more parsimonious presentation of the model. All analyses are conducted using Stata. As shown in the model above, not only the intercept but also the slope ($\beta_2 + \zeta_{2j}$) multilevel models of longitudinal data for women and for men (Raudenbush & Bryk, 2002; Rabe-Hesketh & Skrondal, 2008) of the year squared (x_{2ij}) vary over respondents (j).

An important feature of these models is the assumption that the intercept (ζ_{1j}) and slope (ζ_{2j}) parameters vary across individuals (and interact with time as person-year), so that they become dependent variables in the level two (or person-level) model, where individual characteristics are included as predictors. This is an appropriate strategy as functional status is associated with decline among older adults and observations are therefore not independent from responses in previous waves. The model assumes a normal distribution with an unstructured covariance matrix. Variables had relatively low correlations (all below 0.3).

The qualitative data are analyzed using the Explanatory Design, a two-phase mixed methods design with the objective of using qualitative data to explain or build upon quantitative results (Creswell et al., 2003; Creswell & Clark, 2007). This method is appropriate for providing explanations or mechanisms for otherwise surprising or opaque quantitative results (Morse, 1991).

Results

(1) In the initial model (before controlling for health and illness behaviors and social ties, women experienced sharper rates of functional decline than did men. When gender was added as a covariate, being male was significantly ($p < 0.05$) protective against decline in the basic model (coefficient -0.065). (2) When health and illness behaviors were added to the model, the gender differences in functional decline became more pronounced, although the coefficient for women remained about the same. Being male was no longer significantly associated with functional decline. (3) When the model controlled for social ties (but not health and illness behaviors), the differences between men and women in functional decline became even stronger, suggesting that health and illness characteristics and particularly social ties might be more beneficial for men than for women. Being male was remained not significantly associated with functional decline in this model. (4) The full model, however, suggests that men experience a much more rapid rate of functional decline than do women, controlling for both health and illness behaviors and social ties. This difference is even more pronounced (and reversed) than the gender difference in Model 1. When gender was added to the analysis, we find that being male is significantly ($p < 0.001$) associated with functional decline, a reverse in direction from the Model 1 (coefficient: 0.164) These findings suggest that while individually, health and illness behaviors and social ties might be more beneficial for men relative to women, together health and social ties interact to have protective effects against functional decline, particularly for women, over time.

Table 4.2: Functional Status by Gender (1999-2008): Health and Social Tie Characteristics

	Model 1 (Bare Model)				Model 2 (Health)				Model 3 (Social Ties)				Model 4 (Full Model)											
	Male		Female		Male		Female		Male		Female		Male		Female									
	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z								
_cons	14.219	0.000	***	15.848	0.001	***	12.811	0.026		15.931	0.052	*	13.292	0.022	*	19.611	0.012	*	19.964	0.000	***	13.835	0.071	**
Year	0.034	0.610		0.113	0.111		0.331	0.296		0.349	0.516		0.292	0.164		0.360	0.574		0.299	0.189		0.481	0.349	
Year squared	-0.047	0.022	**	-0.084	0.000	***	-0.103	0.179		-0.094	0.437		-0.080	0.135		-0.130	0.374		-0.073	0.194		-0.118	0.324	
Race / Ethnicity (white ref)																								
Non-Hispanic Black	0.071	0.187		0.281	0.000	***	0.148	0.051		0.189	0.011	**	0.066	0.383		0.080	0.372		0.053	0.478		0.036	0.683	
Hispanic	0.138	0.039	**	0.240	0.001	***	0.092	0.353		0.304	0.002		0.184	0.066	*	0.149	0.176		0.166	0.086	*	0.159	0.150	
Other	0.047	0.723		0.179	0.241		0.169	0.386		0.102	0.621		0.162	0.370		-0.158	0.490		0.077	0.676		-0.056	0.804	
Education (HS ref)																								
LTHS	0.086	0.093	*	0.132	0.019	**	0.075	0.280		-0.041	0.571		0.145	0.040	**	0.027	0.751		0.130	0.062	*	0.004	0.966	
Some College	-0.016	0.774		-0.005	0.935		-0.042	0.564		-0.108	0.226		0.086	0.220		-0.012	0.905		0.088	0.201		-0.078	0.442	
College or More	0.029	0.591		0.082	0.339		0.020	0.787		-0.140	0.209		0.072	0.312		-0.071	0.571		0.146	0.041	**	-0.040	0.744	
Working Status (ref: work)	0.180	0.000	**	0.267	0.000	***	0.120	0.005	**	0.238	0.000	***	0.098	0.006	**	0.209	0.000	***	0.100	0.010	**	0.232	0.000	***
Mean Hhd Assets	0.000	0.454		0.000	0.196		0.000	0.242		0.000	0.147		0.000	0.297		0.000	0.110		0.000	0.140		0.000	0.371	
Age at BL (above 0)	0.003	0.132		0.005	0.114		0.005	0.194		-0.005	0.238		-0.003	0.469		-0.010	0.046		0.000	0.085	*	-0.011	0.022	**
C-ESD	0.122	0.000	***	0.093	0.000	***	0.105	0.000	***	0.098	0.000	***	0.050	0.000	***	0.081	0.000	***	0.038	0.000	***	0.082	0.000	***
Comorbidities	0.012	0.000	***	0.264	0.000	***	0.152	0.000	***	0.177	0.000	***	0.130	0.000	***	0.181	0.000	***	0.114	0.000	***	0.136	0.000	***
Year Diagnosed	0.002	0.000	***	-0.008	0.000	***	-0.007	0.022	**	-0.008	0.041	**	-0.007	0.023	**	-0.009	0.017		-0.010	0.000	***	-0.007	0.078	*
Doc Visits in last 2 Yrs							0.004	0.006	**	0.003	0.039	**							0.003	0.039	**	0.004	0.010	**
Home care (ref: receiving)							0.504	0.000	***	0.735	0.000	***							0.407	0.000	***	0.417	0.000	***
Rate Doc's Performance							0.020	0.123		0.001	0.963								0.046	0.000	***	0.010	0.538	
Weight Level (ref: Right)																								
Underweight							-0.145	0.699		0.273	0.268								0.148	0.718		-0.109	0.674	
Overweight							-0.129	0.025	**	-0.042	0.512								-0.127	0.016	**	-0.094	0.181	
Obese							-0.024	0.834		0.385	0.000	***							-0.052	0.630		0.166	0.086	*
Smoke (ref: smoke)							-0.130	0.069	*	0.201	0.011	**							-0.092	0.149		0.171	0.049	**
Currently Drinking (ref: yes)							0.103	0.008	**	0.126	0.018	**							0.111	0.002	**	0.103	0.079	*
Vigorous Phys. Act (ref: yes)							-0.072	0.045	**	-0.184	0.000	***							-0.019	0.562		-0.062	0.215	

Table 4.2: Functional Status by Gender (1999-2008): Health and Social Tie Characteristics (cont.)

	Model 1 (Bare Model)				Model 2 (Health)				Model 3 (Social Ties)				Model 4 (Full Model)			
	Male		Female		Male		Female		Male		Female		Male		Female	
	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z
_cons	14.219	0.000 ***	15.848	0.001 ***	12.811	0.026 *	15.931	0.052 *	13.292	0.022 *	19.611	0.012 *	19.964	0.000 ***	13.835	0.071 **
Partnership (ref: marr/part)									-0.160	0.114	-0.593	0.000 ***	-0.138	0.207	-0.702	0.000 ***
Informal Care (ref: rec. 2003)									0.109	0.144	0.143	0.058 *	0.016	0.819	0.039	0.592
Support for Adherence (2003)									0.001	0.882	-0.003	0.606	0.008	0.069 *	0.004	0.463
Comp. Partner (ref: same)																
Better									-0.979	0.000 ***	-0.775	0.000 ***	-0.982	0.000 ***	-0.695	0.000 ***
Worse									-0.894	0.000 ***	-0.708	0.000 ***	-0.911	0.000 ***	-0.639	0.000 ***
Living Family																
Parents (ref: 2)																
0									0.030	0.860	-0.276	0.194	0.137	0.449	-0.198	0.361
1									0.039	0.815	-0.205	0.335	0.130	0.475	-0.155	0.477
Siblings (ref: 0)																
1									-0.161	0.010 **	-0.116	0.210	-0.146	0.026 **	-0.180	0.074 *
2									-0.197	0.003 **	-0.162	0.097 *	-0.145	0.035 **	-0.146	0.149
3									-0.220	0.002 **	-0.186	0.066 *	-0.184	0.015 **	-0.188	0.078 *
4 or more									-0.169	0.014 **	-0.113	0.242	-0.134	0.060 *	-0.058	0.558
Children (ref: 0)																
1									0.340	0.007 **	-0.113	0.522	0.414	0.002 **	-0.036	0.839
2									0.269	0.020 **	0.136	0.412	0.285	0.015 **	0.142	0.391
3									0.353	0.003 **	-0.056	0.740	0.350	0.003 **	-0.078	0.641
4 or more									0.360	0.001 ***	0.010	0.949	0.368	0.001 ***	0.038	0.807
Log Likelihood	-7773		-11829		-3447		-3848		-2989		-4206		-2604		-2904	
Level 1, Level 2 Units	6041	1560	7785	1936	2797	680	2768	761	2866	605	3086	618	2448	588	2170	590
Variance at Level 1, 2	0.543	1.624	0.841	1.722	0.513	1.441	0.702	2.996	0.336	0.392	0.631	3.457	0.347	0.557	0.604	1.701
Covariance and Cor (2,1)	1.624	-1.000	-0.208	-1.000	-0.278	-1	-0.907	-0.93	-0.027	-0.539	0.910	-0.923	-0.157	-0.726	-0.378	-0.88
var(2)	0.055		0.025		0.054		0.316		0.006		0.281		0.084		0.108	

Significance Levels: p<.001 (***), p<.05 (**), p<.01 (*)

Table 4.3: Functional Status and Gender Interactions (1999-2008): Health and Social Tie Characteristics

	Model 2 (Health)				Model 3 (Social Ties)				Model 4 (Full Model)			
	Pooled		Interact		Pooled		Interact		Pooled		Interact	
	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z
_cons	12.91	0.004 **			16.72	0.001 ***			13.14	0.005 **		
Year	0.334	0.217			0.360	0.185			0.294	0.220		
Year squared	-0.099	0.122			-0.113	0.084 *			-0.075	0.193		
Race / Ethnicity (white ref)												
Non-Hispanic Black	0.222	0.001 ***	-0.066	0.552	0.062	0.430	-0.009	0.938	0.011	0.890	0.060	0.602
Hispanic	0.273	0.003 **	-0.177	0.221	0.135	0.161	0.034	0.828	0.150	0.121	0.029	0.848
Other	0.087	0.649	0.084	0.774	-0.171	0.395	0.323	0.280	-0.082	0.679	0.213	0.462
Education (HS ref)												
LTHS	0.031	0.651	0.048	0.641	0.041	0.582	0.094	0.412	0.010	0.897	0.098	0.370
Some College	-0.066	0.423	0.025	0.829	-0.004	0.961	0.075	0.549	-0.075	0.397	0.105	0.384
College or More	-0.060	0.563	0.079	0.549	-0.059	0.592	0.121	0.391	-0.028	0.794	0.102	0.451
Working Status (ref: work)	0.232	0.000 ***	0.114	0.111	0.207	0.000 ***	0.110	0.093 *	0.233	0.000 ***	0.142	0.046 **
Mean Hhd Assets	0.000	0.079 *	0.000	0.277	0.000	0.077 *	0.000	0.296	0.000	0.361	0.000	0.720
Age at BL (above 0)	-0.006	0.100	0.011	0.041 **	-0.010	0.020 **	0.005	0.443	-0.013	0.003 **	0.009	0.146
C-ESD	0.100	0.000 ***	0.003	0.810	0.081	0.000 ***	-0.029	0.029 **	0.081	0.000 ***	-0.038	0.009 **
Comorbidities	0.194	0.000 ***	-0.039	0.161	0.177	0.000 ***	-0.043	0.090 *	0.127	0.000 ***	-0.015	0.584
Year Diagnosed	-0.007	0.002 **	0.000	0.569	-0.008	0.001 ***	0.000	0.795	-0.006	0.007 **	0.000	0.546
Doc Visits in last 2 Yrs	0.004	0.003 **	0.000	0.891					0.004	0.003 **	-0.001	0.458
Home care (ref: receiving)	0.509	0.000 ***	-0.016	0.851					0.416	0.000 ***	-0.029	0.739
Rate Doc's Performance	0.003	0.812	0.017	0.379					0.015	0.314	0.032	0.127
Weight Level (ref: Right)												
Underweight	-0.025	0.912	-0.117	0.800					-0.131	0.566	0.239	0.650
Overweight	-0.086	0.912	-0.043	0.622					-0.093	0.131	-0.025	0.778
Obese	0.221	0.008 **	-0.252	0.094 *					0.151	0.075	-0.259	0.088 *
Smoke (ref: smoke)	0.242	0.001 ***	0.372	0.000 ***					0.175	0.022 **	0.247	0.020 **
Currently Drinking (ref: yes)	0.111	0.024 **	0.006	0.931					0.102	0.048 **	-0.010	0.877
Vigorous Phys. Act (ref: yes)	-0.123	0.004 **	0.053	0.357					-0.061	0.168	0.038	0.506

Significance Levels: p<.001 (***), p<.05 (**), p<.10 (*)

Table 4.3: Functional Status and Gender Interactions (1999-2008): Health and Social Tie Characteristics (cont.)

	Model 2 (Health)				Model 3 (Social Ties)				Model 4 (Full Model)							
	Pooled		Interact		Pooled		Interact		Pooled		Interact					
	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z	Coeff	P> z				
_cons	12.91	0.004	**		16.72	0.001	***		13.14	0.005	**					
Partnership (ref: marr/part)					-0.609	0.000	***	-0.475	0.012	**	-0.729	0.000	***	-0.626	0.001	***
Informal Care (ref: rec. 2003)					0.145	0.028	**	-0.065	0.563		0.044	0.497		0.019	0.860	
Support for Adherence (2003)					-0.003	0.523		0.004	0.533		0.004	0.353		0.001	0.873	
Comp. Partner (ref: same)								0.057	0.150					0.075	0.093	*
Better					-0.841	0.000	***				-0.797	0.000	***			
Worse					-0.822	0.000	***				-0.816	0.000	***			
Living Family																
Parents (ref: 2)								-0.090	0.255					-0.074	0.374	
0					-0.212	0.172					-0.121	0.450				
1					-0.128	0.365					-0.061	0.672				
Siblings (ref: 0)								-0.017	0.539					-0.025	0.370	
1					-0.131	0.022	**				-0.144	0.015	**			
2					-0.167	0.011	**				-0.127	0.059	*			
3					-0.186	0.013	**				-0.148	0.057	*			
4 or more					-0.118	0.142					-0.045	0.585				
Children (ref: 0)								0.046	0.173					0.044	0.183	
1					0.069	0.539					0.115	0.303				
2					0.150	0.164					0.133	0.209				
3					0.068	0.558					0.049	0.670				
4 or more					0.087	0.467					0.098	0.410				
Log Likelihood	-7314				-7361						-5570					
Level 1, Level 2 Units	5565	1441			5952	1223					4618	1178				
Variance at Level 1, 2	0.587	1.661			0.492	1.436					0.466	1.091				
Covariance and Cor (2,1)	-0.337	-1			-0.235	-0.946					-0.250	-0.838				
var(2)	0.079				0.043						0.082					

Significance Levels: p<.001 (***), p<.05 (**), p<.10 (*)

Health and Illness Behaviors

The *number of doctor visits* was significantly positively associated ($p < 0.05$) with functional decline for both men and for women in Model 2 and in the full model, but this did not differ significantly between men and women as a predictor of functional decline (as shown in gender interaction tests shown in Table 4.3). Receiving *home care* was also a significant ($p < 0.05$) predictor for functional decline over time for both men and women in Model 2 and in the full model, but the gender differences in home care as a predictor of functional decline were not significant. The ranking of *doctor's performance in managing diabetes* was only a significant predictor of functional status decline among women in the full model, after including the social ties covariates, but is not significant for men in any of the models and the interaction variables was not significant. Relative to those of the right *weight level*, neither men nor women who were underweight experienced a sharper rate of functional decline. Interestingly, being overweight and obese was either a significant risk factor or protective factor depending on gender and on the model. There are strong and significant gender differences in *smoking* as a predictor as functional decline over time, with smoking status being a particular risk factor for functional decline among men. In most cases, *drinking* was significantly positively associated with functional decline for men and women in both Model 2 and in the full model, although the interaction tests were not significant. Finally, *vigorous physical activity* 2-3 times per week or more was significantly negatively associated with health decline among women and men, but only in Model 2 (the effects are no longer significant after the social tie characteristics are included in the full model). The interaction tests were not significant.

Social Ties

Challenging previous findings, *marital/partnership status* was significantly *protective* against functional decline among women. This strengthened in the full model after adding the health and illness behavior covariates. The interaction tests show that marriage status is actually a significant risk factor for functional decline among men (relative to women) over time in both Model 3 and in the full Model, although it was not a significant factor for men in Models 3 or 4. *Informal care* and *support for adherence* were generally not significantly associated with functional decline for either men or women in Models 3 and 4 and the interaction tests are not significant. These variables are from the Diabetes Supplement (informal care and support for adherence) and are time invariant due to limitations in the data. It is possible that significance was not found due to the bi-directional relationship of these factors on functional status. Having a different number *functional limitations than their partners*, whether greater or fewer, negatively ($p < 0.05$) associated with functional decline among men and women in Models 3 and 4. Having a partner with a different functional status was marginally protective for men in the interaction tests. Finally, the association between *number of living family members* and functional decline was contingent upon kind of family relation and gender: number of living *parents* (relative to 2) was not significantly associated with functional decline for men or for women in either model; however, the number of living siblings (relative to 0) was significantly negatively associated with functional decline in models 3 and 4 ($p < 0.05$), but for males only (the significance was only marginal in some cases for women). The number of living children (relative to 0), however, was significantly positively associated with functional decline among men in Models 3 and 4, but not for

women. However, the interaction tests do not show significantly different pathways of whether or not family members remain and functional decline over time.

Discussion

This study examined the relationships between gender, health and illness behavior, and social ties as predictors of functional decline among diabetics of middle and old age. The measures in this analysis did not uniformly operate for men and women and between the bare models and the full models, suggesting that mechanisms conventionally understood to exacerbate health disparities between men and women are indeed situational, population-specific, and highly dependent on which factors are included in the analysis. As discussed previously, in aggregate, functional decline was significantly sharper for women in model 1, but after controlling for health and illness behaviors and social ties *in conjunction*, men are shown to have a significantly steeper rate of functional decline relative to women. The gendered differences regarding interactive roles between health and social ties for functional decline will be discussed here: quantitative data will be elaborated further, supplemented with passages from the qualitative interview data that illustrate or clarify the findings.

Health and Illness Behaviors

Positive health and illness behaviors were hypothesized to protect against functional decline for both men and women and negative health and illness behaviors were hypothesized to be associated with decline for both men and women. Based on previous literature, men's engagement in fewer health-promoting and more health-risk

behaviors would suggest that health and illness behaviors would provide a mechanism by which the gender gap in functional decline would narrow. Despite the findings (Tables 4.1-4.3) that women did engage in more health promotion and fewer health risk behaviors than men, the gender differences in functional decline widened after adding health and illness behaviors into the model. Given that women do engage in more positive health behaviors than men, controlling for these factors exacerbates the differences between men and women in functional status. The qualitative data illustrates that for women, health and illness behaviors are not isolated events, but rather, more strongly influence the way in which they interact with others. Further, the social environment is more strongly embedded into women's overall experience with diabetes relative to their male counterparts.

Perceived Physician's Performance

Interestingly, perceived performance of physicians in managing chronic illness is only a significant predictor of functional decline for men and only after controlling for social ties. Therefore, male respondents' rankings are predictive of functional decline only when taking men's social ties into consideration. The relationship between rankings of providers and change in functional decline is likely to be stronger among patients who rely more on their providers for advice, while the relationship is likely to be weaker among patients who seek advice elsewhere. Previous research suggests that men have fewer social ties than women and tend to rely on their spouse to a greater extent than do women, who tend to have more extensive networks for support. As discussed previously, women tend to seek more preventative care and health information independently relative to men. Men who are relatively more involved in more extensive social networks and

who rely on others for health information might rely relatively less on their providers as the sole source of information for management of their chronic illness. The qualitative data suggest that provider interactions are important for both men and women. However, the women sampled tended to embed experiences with providers within their own experiences and knowledge about diabetes, while the men sampled tended to refer to such relationships as distinct from their own experiences. For example, a woman in her late 70s who is currently married describes how she discovered that her diabetes had progressed to the point that she needed dialysis:

—My doctor came into a meeting with me and told me I would need dialysis and that was a rude awakening: I was upset, he was upset, the nurse was upset...we were all upset and we kind of hugged and kissed because it was a big step.”

Another woman (65, married) discusses the interactive relationship she has with her provider in helping her manage her diabetes:

—If I feel if something is wrong with me—for instance, with my sugar—if I take my sugar two days in a row and it’s too low, I call him and say, _What’s wrong with my sugar level‘ and he’ll say _I don’t know, what have you been doing?’ and I’ll tell him. He’ll say, _What did you eat? Are you taking your medicine on time?’ Then he would say, _You think it’s a problem?’ and I’ll say, _Yes‘ (if it’s low two days in a row), and he’ll say, _Well, you should readjust the amount you take. And after you adjust it for two days if it doesn’t change call me and let me know at once.’ So our relationship is very good. I’m very comfortable with him as a doctor.

In contrast, when posed open-ended questions about experiences with providers, male respondents generally had specific complaints regarding their providers in addition to the overall relationship. For example, a married man in his late 60s stated:

—I think she’s a very good doctor, very good as far as her knowledge but I think she overprescribes. Every time you get a symptom she gives you another pill for it and I think a lot of doctors do that. But those aren’t cures, those are just temporary fixes, they don’t

really do any good. You have to do something; your own body will take care of things on its own if you give it a chance.”

After describing a complaint that a previous physician would not visit him in the hospital, a single man in his early 60s discussed his relationship with his current provider:

“I think it’s a love-hate relationship. That’s about it. I like him and I think he’s provided me with good care but I’m beginning to wonder if he’s thorough enough, is he willing to try some new methods. And it seems like it isn’t working . . . but I’m too chicken to talk to him about it . . . it’s probably a kind of fear . . . like talking to a parent or a spouse.”

The relationship that ratings of a provider’s management of diabetes and functional decline was only significant for men and after controlling for social ties. Although men and women seem to invest emotionally in their interactions with their providers, the qualitative data suggest that men have specific goals (and as a result, specific complaints) for these relationships, which are often unrealistic. As discussed previously, women are more used to engaging in relationships toward prevention and management than are men and therefore might have less targeted expectations or goals than do men. For men in particular, the degree to which individuals are able to spread the sources the sources of health information and support across non-medical social ties, the more effective patient-provider interactions most likely are. More research should be done to elucidate these gender-and network-specific relationships.

Physical Activity, Diet, and Social Ties

As discussed previously, being overweight was protective against decline for men only in both Model 2 and the full model, while being obese was a significant risk factor for women only in Model 2 and a marginal risk factor for women only in the full model

(with reduced effects after taking social ties into consideration). The significantly beneficial long-term outcomes of physical activity for men—and, in particular—women, seem to be highly linked with social ties, as these relationships are weakened and no longer significant in the full model. As previous literature has found that women have healthier eating habits than men (Denke, Sempos, & Grundy, 1993; Oleckno & Blacconiere, 1990; Oppenheim, 1994; Shi, 1998; Walker et al., 1988; Weissfeld, Kirsch, & Brook, 1990) and engage in physical activity generally more geared toward health and wellness (Dean, 1989; Walker et al., 1998; Weissfeld, Kirsch, & Brooke, 1990). Further research should address the interplay of gender, social ties, and the health effects of obesity: social ties matter for obese women's rate of functional decline but social ties do not appear to matter for the protective factor of being overweight for men's rate of functional decline.

The qualitative interviews provided rich data to explain the processes by which social ties can be beneficial for physical activity as well as for keeping weight under control. Both male and female respondents with wider social networks (relative to respondents who relied on only one person for social support) generally engaged in more physical activity. For example, a married man in his late 60s reports some of the benefits of having friends and a spouse who are physically active:

“I play tennis and softball . . . [with] some buddies [and] my wife goes to swim. . . We're members at the Y” and they have all the facilities there, so you might as well use them.”

As illustrated by a respondent (a widowed woman in her late 60s), the companionship makes physical activity more enjoyable, routine, and in many cases, safer:

–Used to walk around the neighborhood but you have to go up and down hills and it’s hard for me to go up and down hills. And I fell a couple of times before . . . and I was alone and I didn’t want to take a chance on hurting myself. I have a friend who comes over a couple of times a week to visit me and we sometimes walk around the neighborhood and we sometimes walk around the recreation center.”

In interviews, respondents also expressed ways in which friends were helpful in helping them keep their weight under control and adhering to the diabetic diet. In most cases, this was most helpful when the respondents’ friends were also diabetic or experiencing a chronic illness that also required dietary changes. For example, a divorced woman in her late 50s, describes a friend who is required to lose weight for cancer:

–Since [she] has become the carb queen, she says, ‘_did you eat this?’ in fact, she went to a meeting with me, I introduced her as the carb queen. When we go out to eat, she checks to see what I order. And grocery shopping and stuff like that. Some people at a point get angry and say . . . ‘_I’m eating hot wings’ but I guess most of the time I don’t.”

By the same token, the qualitative data suggest that social relationships may also affect health in ways that are not beneficial. Individuals’ exercise routines might be interrupted if the members of their social network with whom they exercise are no longer able to do so. For example, a widowed woman in her early 80s discusses how this routine can be interrupted:

–[My friend and I] took yoga for a while and then we kind of fell out of it because she had a knee replacement so we are going to re-up for the yoga.”

Dependency on others for engaging in physical activity can therefore be a double-edged sword: it can help to establish a routine; however, it can also easily be disrupted, particularly if one relies on only one activity partner. In other cases, some social groups

may make consuming unhealthy food a part of their regular social activities. This can be dangerous for adherence to the diabetic diet and for keeping weight under control, as discussed by a widowed female in her late 60s:

–Sometimes I eat a lot that I shouldn't eat, like on Wednesdays we have a euchre club, and we have snacks to eat and dessert, and I always eat some of the snacks and some of the dessert and I eat my dinner afterwards.”

Thus, as research by Christakis and Fowler (2007) suggest, social networks can have a powerful impact on health behaviors, and, hence on obesity.

The communities in which people live—beyond their immediate social networks—can also influence the extent to which people engage in physical activity and keep their weight under control. Beyond food affordability and availability, beyond neighborhood safety and walkability, it can be the social cohesion and friendliness of a community that can promote healthy behaviors, as described by a single female in her late 70s:

–You see people walking and biking all over the place, and there are plenty of places . . . to go exercise. I think the community is friendly toward [diabetics].

One respondent (a divorced woman in her late 50s) reflects on an intervention that she pioneered to raise awareness of effective health promotion and diabetes control in her neighborhood:

–We started another organization and we would have people and talk about diabetes and nutritionists come [to the African American community] and we would have health fairs and stuff. In the past, they've done a lot to try to educate people and I'm sure they helped them very much, knowing what other people went through.”

Finally, some respondents described situations in which having diabetes actually expanded their social networks, as discussed by a widowed woman in her late 60s:

—noticed somebody that had lost a lot of weight and I said, —You really lost a lot of weight,” and she said —yea I got type II diabetes.” And I said, —Oh I know exactly what you are talking about, not eating too many carbs huh?” And that leads us into talking food. So it’s a social phenomenon for me. . . . Well, if you have something more you can talk about to somebody than you have more interactions and I’m very open about most of the things that go on. . . . It just gives you something more in common with other human beings.

In sum, the influence of health and illness behavior on functional decline differs greatly by gender as well as by social ties and social engagement. The qualitative data suggests that social ties and social relationships are important mechanisms for the ways in which individual interact with healthcare providers, engage in physical activities, and keep their weight under control.

Social Ties

Marriage/Partnership

This analysis found that being in a marriage/partnership was significantly protective against functional decline among women, but not among men—which was further strengthened when the health characteristics were included in the final model. This challenges previous research suggesting that marital benefits are strongest for men, but are protective for women as well (Schoenbach et al., 1986; Schone & Weinick, 1998; Shye et al., 1995; Waite, 1995). In this analysis, marriage/partnership is protective for women in the sample, but the magnitude differs according to the health and illness behaviors. Although studies have found that marriage is beneficial for both men and

women due to better accumulated health behaviors over the life course (Schoene & Weinick, 1998; Waite, 1995), this conclusion challenges the finding that marriage is associated with better health behaviors for men but not for women (Brown & McCreeley, 1986; Camacho & Wiley, 1983). Given that women are more likely than men to be living alone at every stage—and increases with age—the health benefits of partnership for women are not difficult to fathom (Spitze & Logan, 1989; Umberson, 1987). It could be that the reverse—being alone or experiencing the trauma or stress of widowhood or divorce—is a stronger risk factor for women, rather marriage being beneficial (and is strong enough to offset any positive effects for men in the sample).

Advanced physical disability could put individuals at risk for social isolation. As discussed previously, social isolation could negatively influence health through depression or by not getting the tangible care he or she needs. On the other hand, if an individual who is physically disabled has a vast social network, they can receive tangible support (from sources such as one's partner, other family, friends, or members of the community). In some cases, physical disability can exacerbate depression and feelings of loneliness and helplessness. A 63-year old female widow describes her experience with loneliness following the loss of her husband:

—I felt I reached a point where I don't really have any excitement to look forward to. . . . I'm not planning on climbing Mount Everest. Here I am alone and I have a lot of uncertainty about the future I just miss sharing. My children just don't really understand. They haven't been with me. They haven't gone through old age. At old age, you want to go back and share but I don't have anyone to share with.”

For those with advanced functional limitations, tangible support from friends and family can fulfill more than the immediate needs at hand. This form of support provides social contact and indications of affection, which is particularly important among those who

live alone and are house-bound. One respondent in her late 50s (widowed) described the help she received from her family with pride:

—My sister has been doing the laundry for me. Because I can't go down in the basement, I can't use the steps. My son takes out the trash But they are both willing to do [these things]. They both go to the grocery store for me occasionally or to the pharmacy to pick up prescriptions.”

Therefore, the extent to which individuals can rely on others for social, emotional, and tangible support is particularly important for who those are disabled and who live alone. Since receiving home care is often a proxy for severe disablement, and could also be a proxy for living alone among women, the provision of these forms of support could be key elements to preventing further decline. As women are more likely to be alone later in life, they are more likely to be in greater need of support and assistance (Spitze & Logan, 1989; Verbrugge 1985; 1987). The population sampled is also relevant - - diabetics over the age of 50: the ability for a spouse or partner to provide care or support might positively affect functional status for women as well.

The qualitative data suggest several processes through which marriage is protective for both men and women, but that the beneficial effect can end with the dissolution of the marriage through divorce or death. Spouses provide emotional and tangible support to one another, but the loss of a spouse through widowhood or divorce can reduce support and social engagement.

Tangible support—often in the form of food preparation—was a prominent mechanism through which spouses and partners were described as helpful by the respondents, particularly by females. This finding is in agreement with Umberson's

(1987, 1992) research that marriage is protective against health decline due largely to health behaviors. One respondent (married female in early 50s) describes how her husband has provided tangible support in helping her with her diabetes regimen:

—Now that he's not working he's learning to cook and he provides the meals. He cooks whatever fits in with my diet choices, he sets the menu and does the shopping and fixes the food we're used to eating. He always asks, —Do you want to eat this? Is this ok?"

In other cases, spouses provide reminders against foods —off limits" from the diabetes regimen. This form of social control can be helpful for those who are knowledgeable about adhering to a regimen, as discussed by a married woman in her early 70s:

—If he sees me eating a lot of cookies he'll say, —You aren't supposed to have that." So [he'll remind me]. He's aware and I think to myself that he's not as educated as I am about what goes into my body, but he's right."

Male respondents emphasized the additional knowledge and research that their partners contributed to help them manage their diabetes. One respondent (married male in late 60s) discusses the assistance his wife provides him in accompanying him to the doctor:

—She goes in with me because the doctor explains to her what's going on because she understands."

Chronic illnesses, which often entail functional limitations, can impose challenges on partnerships. Couples can cope with these challenges in different ways that can either strengthen or weaken the bond of the relationship. For example, a married male in his early 70s described how his disability had brought a new appreciation of his wife:

—[Diabetes] has gotten in the way of having sex, [but] we're still very intimate. That's

another reason I think [my wife is] the cat's pajamas She's just the best there is . . . [The marriage] is the most wonderful thing in my life.”

Marriages and partnerships can offer emotional and tangible support to those with chronic illnesses, which can be protective against negative health events. However, relationships can also be toxic. One woman (early 60s) described problems in her marriage that she had endured much of her life before she became a widow:

–He was an alcoholic. He wasn't physically abusive but he was emotionally abusive. I guess I got married when I was too young. . . He was just used to being taken care of. He demanded that the house always be clean, clean dishes, food in the refrigerator and that was ready. He had a whole list of demands.” I told him I wanted to go to college and he said that I wouldn't be able to remember anything. Our whole marriage was tension-filled. He didn't give me any support, he just gave me a whole list of things I needed to do. I was always on my toes; I just felt like everything had to be perfect. . . He would be angry otherwise.”

The respondent described a relationship filled with stress and lacking in support and control. Both physically and emotionally demanding, the psychological effects of this relationship alone would likely be related to more rapid functional decline. The loss of a spouse through death or divorce is also a stressful life event that can also lead to a sudden change in social or emotional support. Therefore, many of the protective effects of marriage and partnerships can be suddenly disrupted. A respondent in her late 60s who had recently become a widow expressed some of the devastating effects that widowhood can have on social engagement. When asked about changes in her regular activities, she replied:

–[I go] to church less often. It makes me feel bad because we always went together. We liked to watch boats. We used to like to go to Port Huron and watch the big freighters. In the summertime, they had little personal water crafts. In the winter, we would walk around the mall for exercise. But I won't be doing that anymore.”

In the qualitative sample, marriages and partnerships were generally found to provide social, emotional, and tangible support to both male and female respondents. In the sample wives—whether diabetic or not—tended to be the “experts” of diabetes health information and interacting with providers, while a number of husbands became involved in the preparation of diabetic-friendly food for their wives after retirement. Women who had become widowed or divorced at younger ages showed greater signs of functional and diabetic decline. Further, women in the sample had been financially dependent upon their spouses. Widowhood and divorce seemed to negatively affect women in the sample to a greater extent than men. Together, these findings help explain the quantitative results that marriage is protective against functional decline for women only. However, these relationships should be revisited in future research populations with other chronic illnesses and in different age groups.

Family: Helpful and Harmful

Interestingly, the number of living family members (which have been pointed to as sources of support for women in particular in previous literature) was only significantly associated with functional status for men (with children positively and siblings negatively associated with decline). This suggests that among chronically ill men, having siblings (almost regardless of the number) is protective and having children is a risk factor, although these gender differences are reinforced by the interaction model.

The qualitative data reveal what remains nebulous in the quantitative analyses. In the quantitative analysis, men’s functional decline was positively associated with living children and negatively associated with living siblings. Women’s functional decline was not significantly associated with the number of family members still living. The lack of

association between living family members and functional decline is counter-intuitive and contradicts most of the literature in this area. One explanation would be that children and siblings can have both positive and negative effects on women, which would reduce the effects in the models. The qualitative sample shows that having siblings and children can have both positive and negative consequences.

The qualitative sample brings in several examples of how children, siblings, and parents provide support (tangible, social, and emotional) to respondents. These positive impacts, such as friendship, helping with tasks, providing money for vacations, and providing support for adhering to a regimen are often offset by negative events in the lives of these family members that resulted in strain on the respondents. By the same token, the qualitative data show some negative consequences (the death of a child was described as among the most traumatic events in respondents' lives). For example, a married respondent in her early 60s revealed that, due to her son's poor health and unemployment, they had to take a second mortgage on their home. In addition, a divorced woman in her late 50s discussed the difficulty of being in the "sandwich generation" in taking care of children as well as an ill parent:

"I had a stroke and I remember taking [my mother] to the doctor with me and they . . . wanted to keep me in the hospital and I asked them if my mother could stay with me and they said no. . . . I said I can't leave her alone by herself because she has Alzheimer's. One doctor was very angry because I was not going to stay. . . . They gave me medication and I went home with my mom."

In short, can be both positive and negative for women and this may explain the lack of association in the quantitative study. The reasons why siblings are protective (such as providing tangible support, social support, friendship), and why children are a risk factor (such as financial or social strain) merits further research in qualitative samples. Further,

more should be understood regarding the risk and protective factor of non-related or surrogate family members.

Spousal Support: Differences in Limitations

Relative to having the same functional status as one's partner, being relatively better off than one's spouse *and* relatively worse off is protective against health decline. Informal care and disease-related support are not likely explanations for this relationship (as they were not significant across models). Despite previous evidence for the strains of providing informal care, particularly to a spouse (Spitze & Logan, 1989, Noelker & Wallace, 1985; Sherman et al., 1988), while others have pointed out more positive aspects of caregiving (Braithwaite, 2000; Charmaz, 1993). The findings from this analysis might offer some support for both. On the one hand, several respondents referred to the challenges of caring for a disabled spouse. For one respondent, caregiving was so difficult she actually experienced some relief when her husband died:

—We found out he had a brain tumor. . . . He was getting really bad in a hurry and I couldn't take care of him. . . . He would go out into the kitchen and put one of the burners and put the teakettle on but instead of putting in on the one with the burner he's turn on another burner. We had a gas stove this time and I just couldn't keep track of him so I had to take him back to the hospital. . . . So I'd be with him as much as possible, but you know it was, he just kept going downhill and I kept wanting him to be better all the time but he finally died and I guess after his death it was easier for me because I couldn't hope anymore.”

On the other hand, some respondents alluded to potential benefits to caregiving. For one respondent, caregiving prevented her from slipping into a depression and allowed her to maintain a feeling of control over her husband's illness:

—Used to help him with the bag. You know, changing it. Going to the bathroom. Taking

a bath. He could take his bath without the bag. Take the bag off. Then we would have to put another on. . . . I would never be able to leave the house until he had his shower and make sure he had it on. Then he got an infection from it. Then the bag wasn't always working right. Finally we got it to work right. They gave us the—it was the fourth bag. They gave us the wrong part of it. We finally got it straightened out. . . . Then I had to try to help him a bit. You can't be depressed because I'll tell you what: I couldn't depress him.”

This is an example of the potentially helpful effect of caregiving. In short, the qualitative data lend support to the studies of the challenges of caregiving and studies has that caregiving has a beneficial effect.

Given that having a partner/spouse with a different functional status than one's own (either better or worse) was protective, further research should address the supportive relationships between partners who are both facing a combination of chronic illness, health decline, disability (and gendered effects of marriage at different life stages). Much can be learned from this research that can tailor interventions focusing on family units and social situations, rather than isolating individuals from potential resources in their social environments.

Limitations

This study is limited to men and women with diabetes in mid- and late life. This is a special group not generalizable to the rest of the population in their age group: while individuals must have been well enough to survive to initial data collection, diabetics are generally of worse health and lower socioeconomic status than are non-diabetics in the population. Further, the functional decline of those with diabetes is much more rapid than the average population (Wu et al., 2003). Subsequent research must investigate how the uniqueness of this population influences the findings of these particular study findings

(such as the finding that marriage is protective against functional decline for women but not men). The applicability of these findings to other chronic illnesses is not known and warrants further study.

In addition, the quantitative portion study uses only one dimension of health – disability measured through the presence or absence of functional limitations, while health should be more appropriately conceptualized as a wide array of overall physical, psychological, and social well-being. However, functional status was a useful tool as self-reports have been found to be accurately reported by men and women appropriate to measure over time (Macintyre, Ford, Hunt, 1999; Merrill et al., 1997).

As with most social and epidemiological studies based on survey research, there could be a problem related to omitted variable bias. Several other social factors have been introduced in the literature to explain gender disparities in health over the life course, which cannot all be addressed here. In short, these include biological factors, different occupational and environmental exposures, differential exposure to life events (see Thoits, 1987; Kessler, 1979; Kessler & McLeod, 1984), economic stress on health (Wheaton, 1990; McLeod, 1984; Bolger et al., 1990), stress may be experienced and embodied differently by gender (Aneshensel, Rutter & Lachenbruch, 1991; Horowitz, Raskin White & Howell-White, 1996; Umberson et al., 1996). Despite the care taken to take temporal precedence into account, the quantitative model was not able to parse out within-year (simultaneous) observations. In addition, several measures are time-invariant due to data limitations (such as informal care and social support) which limit the ability to analyze the relationship between these factors and outcomes over time by gender. To gain a more elaborate understanding of the causal relationships between these structurally

linked characteristics and functional status, additional analysis is needed of direct and indirect effects of gender and functional status with health and illness behavior and social tie characteristics over time, preferably comparing on different socio-demographic groups. In life course analyses, it is important to note that analyses might be complicated by changing social roles and embodiment (Macintyre et al., 1996; McDonough & Walters, 2001; Thoits, 1987; Umberson, Chen et al., 1996), requiring a contextual analysis of historical time and place.

Conclusions and Implications

As discussed above, this study found that a number of factors were both gender- and context specific predictors of disability in our qualitative and quantitative samples. Specifically, this study found that social ties interacted with health characteristics to predict functional decline. As little research has examined both social and health-related factors as mechanisms for long-term outcomes between men and women, more work is needed that qualitatively examines these relationships and explores these relationships in greater depth, preferably to additional populations. Future research should also address how biological sex differences and change might interact with these processes. From a policy and practice perspective, medical care and interventions should turn away from gender-neutral (or male-dominated) models of treating chronically ill patients and instead differentiate treatments according to gender patient resources (Baider & Bengel, 2001; Berkman, 2000; Westmaas et al., 2002). In addition, the results show strong interactive relationships between gender, social ties, health factors, and subsequent disability. Although research has made tremendous strides in the field of social support, further

studies must address how different forms of support operate as mediators according to gender, as well as more about the gendered notions of how support and social relationships relate to illness and health. Such research is a precursor to identifying gender- and socially-appropriate interventions for chronically ill populations.

References

- Abraham, I. L., & Krowchuk, H. V. (1986). Unemployment and health: Health promotion for the jobless male. *Nursing Clinics of North America*, 21(1), 37-47.
- Aneshensel, C. S., Rutter, C. M. & Lachenbruch, P. A. (1991). Social structure stress, and mental health: competing conceptual and analytical models. *American Sociological Review*, 56, 166-178.
- Annandale, E., & Hunt, K. (1990). Masculinity, femininity and sex: An exploration of their relative contribution to explaining gender differences in health. *Sociology of Health & Illness*, 12(1), 24-46.
- Baider, L., & Bengel, J. (2001). Cancer and the spouse: Gender-related differences in dealing with health care and illness. *Critical Reviews in Oncology/Hematology*, 40, 115-123.
- Beach, S. R., Schulz, R., Williamson, G. M., Miller, L. S., Weiner, M. F., & Lance, C. E. (2005). Risk factors for potentially harmful informal caregiver behavior. *Journal of the American Geriatric Society*, 53, 255-261.
- Berkman, L. F. (1984). Assessing the physical health effects of social networks and social support. *Annual Review of Public Health*, 5, 413-432.
- Berkman, L. F. (2000). Social support, social networks, social cohesion and health. *Social Work in Health Care*, 31(2), 3-14.
- Berkman, L. F., & Breslow, L. (Eds.). (1983). *Health and ways of living: The Alameda County Study*. New York: Oxford University Press.
- Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*, 51, 843-857.
- Berkman, L. F., Leo-Summers, L., & Horwitz, R. I. (1992). Emotional support and survival after myocardial infarction: A prospective, population-based study of the elderly. *Annals of Internal Medicine*, 117, 1003-1009.
- Bird, C. E., & Rieker, P. P. (1999). Gender matters: An integrated model for understanding men's and women's health. *Social Science & Medicine*, 48, 745-755.
- Bird, C. E., Fremont, A. M., Bierman, A. S., Wickstrom, S., Shah, M., Rechter, T., Horstman, T., & Escarce, J. J. (2007). Does quality of care for cardiovascular disease and diabetes differ by gender for enrollees in managed care plans? *Women's Health Issues*, 17, 131-138.
- Blazer, D. G. (1982). Social support and mortality in an elderly community population. *American Journal of Epidemiology*, 115(5), 684-694.

- Block, G., Rosenberger, W. F., & Patterson, B. H. (1988). Calories, fat and cholesterol: Intake patterns in the U.S. population by race, sex, and age. *American Journal of Public Health, 78*(9), 1150-1155.
- Bolger, N., DeLongis, A., Kessler, R. C., & Westington, E. (1990). The microstructure of daily role related stress in married couples. In J. Eckenrode, & S. Gore (Eds.), *Stress Between Work and Family* (pp. 95-1-5). New York: Plenum Press.
- Bovbjerg, V. E., McCann, B. S., Brief, D. J., Follette, W. C., Retzlaff, B. M., Dowdy, A. A., Walden, C. E., & Knopp, R. H. (1995). Spouse support and long-term adherence to lipid lowering diets. *American Journal of Epidemiology, 141*(5), 451-460.
- Braithwaite, V. (2000). Contextual or general stress outcomes: Making choices through caregiving appraisals. *The Gerontologist, 40*(6), 706-717.
- Broadhead, W. E., Kaplan, B. H., James, S. A., Wagner, E. H., Schoenbach, V. J., Grimson, R., Heyden, S., Tibblin, G., & Gelbach, S. H. (1983). The epidemiological evidence for a relationship between social support and health. *American Journal of Epidemiology, 117*(5), 521-537.
- Brown, J. S., & McCreedy, M. (1984). The Hale elderly: Health behavior and its correlates. *Research in Nursing and Health, 9*, 317-329.
- Burda, P. C., Vaux, A. C., & Schill, T. (1984). Social support resources : Variation across sex and sex role. *Personality and Social Psychology Bulletin, 10*, 119-126.
- Camacho, T. C., & Wiley, J. (1983). Health practices, social networks, and changes in physical health. In L. F. Berkman & L. Breslow (Eds.), *Health and ways of living* (pp. 176-209). New York: Oxford University Press.
- Charmaz, K. C. (1993). *Good days, bad days: The self and chronic illness in time*. New Brunswick, NJ: Rutgers University Press.
- Chou, A. F., Brown, A. F., Jensen, R. E., Shih, S., Pawlson, G., & Scholle, S. H. (2007). Gender and racial disparities in the management of diabetes mellitus among Medicare patients. (2007). *Women's Health Issues, 17*, 150-161
- Correa-de-Araujo, R., Stevens, B., Moy, E., Nilasena, D., Chelsey, F., & McDermott, K. (2006). Gender differences across racial and ethnic groups in the quality of care for acute myocardial infarction and heart failure associated with comorbidities. *Women's Health Issues, 16*, 44-55.
- Courtenay, W. H. (2000). Behavioral factors associated with disease, injury, and death among men: Evidence and implications for prevention. *The Journal of Men's Studies, 9*(1), 81-142.
- Creswell, J. W., & Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

- Creswell, J. W., Clark, V. L., Gutmann, M., & Hanson, W. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage.
- Cwikel, J. M., Dielman, T. E., Kirsch, J. P., & Israel, B. A. (1988). Mechanisms of psychosocial effects on health: The role of social integration, coping style, and health behavior. *Health Education Quarterly*, *15*, 151-173.
- Dean, K. (1989). Self-care components of lifestyles: The importance of gender, attitudes and the social situation. *Social Science and Medicine*, *29*(2), 137-152.
- Denke, M. A., Sempos, C. T., & Grundy, S. M. (1993). Excess body weight: An underrecognized contributor to high blood cholesterol levels in white American men. *Archives of Internal Medicine*, *153*, 1093-1103.
- Doyal, L. (1995). *What Makes Women Sick: Gender and the Political Economy of Health*. New Brunswick, NJ: Rutgers University Press.
- Elder, G. H. (1998). The life course as development theory. *Child Development*, *69*(1), 1-12.
- Elder, G. H., & Liker, J. K. (1982). Hard times in women's lives: Historical influences across forty years. *American Journal of Sociology*, *88*, 362-369.
- Enterline, P. E. (1961). Causes of death responsible for recent increases in sex mortality differentials in the United States. *Milbank Memorial Fund Quarterly*, *38*, 313.
- Eraker, S. A., Kirscht, J. P., & Becker, M. H. (1984). Understanding and improving patient compliance. *Annals of Internal Medicine*, *100*(2), 258-268
- Ettinger, W. H., Fried, L. P., Harris, T., Shemanski, L., Schulz, R., & Robbins, J. (1994). Self-reported causes of physical disability in older people: The cardiovascular health study." *Journal of the American Geriatrics Society*, *42*(10): 1035-44.
- Fischer, C. S., & Oliker, S. J. (1983). A research note on friendship, gender, and life cycle. *Social Forces*, *62*(1), 124-133.
- Foerster, S. B., & Hudes, M. (1994). *California dietary practices survey: Focus on fruits and vegetables, trends among adults, 1989-1993*. Sacramento, CA: California Department of Health Services.
- Frankenhaeuser, M., Lundberg, U., Fredrikson, M., Melin, B., Tuomisto, M., Myrsten, A., Bergman-Losman, B., Hedman, M., Wallin, L. (1989). Stress on and off the job as related to sex and occupational status in white-collar workers. *Journal of Organizational Behavior*, *10*(4), 321-346.
- Friedman, H. S., & Booth-Kewley, S. (1987). Personality, Type A behavior, and coronary heart disease: The role of emotional expression. *Journal of Personality and Social Psychology*, *53*(4), 783-792.

- Fuhrer, R., & Stansfeld, S. A. (2002). How gender affects patterns of social relationships and their impact on health: A comparison of one or multiple sources of support from "close persons". *Social Science & Medicine*, *54*, 811-825.
- Gallant, M. P. The influence of social support on chronic illness self-management: A review and directions for research. *Health Education and Behavior*, *30*, 170-195.
- Galuska, D. A., Serdula, M., Pamuk, E., Siegel, P. Z., & Byers, T. (1996). Trends in overweight among U.S. adults from 1987 to 1993: A multistate telephone survey. *American Journal of Public Health*, *86*(12), 1729-1735.
- Glass, T. A., Dym, B., Greenberg, S., Rintell, D., Roesch, C., & Berkman, L. F. (2000). Psychosocial intervention in stroke: Families in recovery from stroke trial (FIRST). *American Journal of Orthopsychiatry*, *70*, 169-181.
- Goldberg, H. (1976). *The hazards of being male: Surviving the myth of masculine privilege*. Plainview, NW: Nash Publishing.
- Gorman, B. K., & Read, J. G. (2006). Gender disparities in adult health: An examination of three measures of morbidity. *Journal of Health and Social Behavior*, *47*, 95-110.
- Gregg, E. W., Gu, Q., Cheng, Y. J., Narayan, V., & Cowie, C. C. (2007). Mortality trends in men and women with diabetes, 1971 to 2000. *Annals of Internal Medicine*, *147*(3), 149-155.
- Gruninger, U. J. (1995). Patient education: An example of one-to-one communication. *Journal of Human Hypertension*, *9*(1), 15-25.
- Halfon, N., & Hochstein, M. (2002). Life course health development: An integrated framework for developing health, policy, and research." *Milbank Quarterly*, *80*, 433.
- Hammarstrom, A. (1994). Health consequences of youth unemployment: Review from a gender perspective. *Social Science and Medicine*, *38*(5), 699-675.
- Harrell, J. S., Bangdiwala, S. I., Deng, S., Webb, J. P., & Bradley, C. (1998). Smoking initiation in youth: The roles of gender, race, socioeconomic, and developmental status. *Journal of Adolescent Health*, *23*(5), 271-279.
- Hochschild, A. (1989). *The second shift*. Viking, New York.
- Horowitz, A. V., Raskin White, H., & Howell-White, S. (1996). The use of multiple outcomes in stress research: A case study of gender differences in response to marital dissolution. *Journal of Health and Social Behavior*, *37*, 278-291.
- House, J. S., Landis, K. R., & Umberson, D. (1988). Social relationships and health. *Science*, *241*, 540-545.

- House, J. S., Robbins, C., & Metzner, H. L. (1982). The association of social relationships and activities with mortality: Prospective evidence from the Tecumseh Community Health Study. *American Journal of Epidemiology*, *116*(1), 123-140.
- Hurdle, D. E. (2001). Social support: A critical factor in women's health and health promotion. *Health & Social Work*, *26*(2) 72-79.
- Kandrack, M., Grant, K. R., & Segall, A. (1991). Gender differences in health related behavior: Some unanswered questions. *Social Science and Medicine*, *32*(5), 597-590.
- Kang, S. H., Bloom, J. R., & Romano, P. S. (1994). Cancer screening among African-American women: Their use of tests and social support. *American Journal of Public Health*, *84*, 101-103.
- Kann, L., **Update with new Youth risk behavior surveillance—United States, 1997. *Morbidity and Mortality Weekly Report*
- Kaplan, G. A. (1985). Psychosocial aspects of chronic illness: Direct and indirect associations with ischemic heart disease mortality. In R. M. Kaplan & M. H. Criqui (Eds.), *Behavioral epidemiology and disease prevention* (pp. 237-269). New York: Plenum.
- Kaplan, H. B. (1991). Social psychology of the immune system: A conceptual framework and review of the literature. *Social Science and Medicine*, *33*(8), 909-923.
- Kaplan, S., Gandek, B., Greenfield, S., Rogers, W., Ware, J. E. (1995). Patient and visit characteristics related to physicians' participatory decision-making style. Results from the Medical Outcomes Study. *Medical Care* *33*(12), 1176-1187.
- Kessler, R. C. (1979). Stress, social status, and psychological distress. *Journal of Health and Social Behavior*, *20*, 259-272.
- Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshelman, S., Wittchen, H. U., & Kendler, K. S. (1994). Lifetime and 12-month prevalence of *DSM-II-R* psychiatric disorders in the United States: Results from the National Comorbidity Survey. *Archives of General Psychiatry*, *51*, 8-19.
- Kessler, R. C., McLeod, J. D. (1984). Sex differences in vulnerability to undesirable life events. *American Sociological Review*, *49*, 620-631.
- Kirschbaum, C., Klauer, T., Filipp, S., & Hellhammer, D. H. (1995). Sex-specific effects of social support on cortisol and subjective responses to acute psychological stress. *Psychosomatic Medicine*, *57*, 23-31.
- Langa, K. M., Vijan, S., Hayward, R. A., Chernew, M. E., Blaum, C. S., Kabeto, M. U., Weir, D. R., Katz, S. J., Willis, R. J., & Fendrick, A. (2002). Informal caregiving for diabetes and diabetic complications among elderly Americans. *Journal of Gerontology*, *57B*, S177-S186.

- Leigh, J. P., & Fries, J. F. (1993). Associations among healthy habits, age, gender, and education in a sample of retirees. *International Journal of Aging and Human Development*, 36(2), 139-155.
- Lepore, S. J., Allen, K. A., & Evans, G. W. (1993). Social support lowers cardiovascular reactivity to an acute stressor. *Psychosomatic Medicine*, 55, 518-524.
- Liang, J., Bennett, J. M., Shaw, B. A., Quinones, A. R., Ye, W., Xu, X., & Ofstedal, M. B. (2008). Gender differences in functional status in middle and older age: Are there any age variations? *Journal of Gerontology*, 63(5), S282-92.
- Li, H., Chadiha, L. A., & Morrow-Howell, N. (2005). Association between unmet needs for community services and caregiver strain. *Families in Society*, 86(1), 55-62.
- Lonnquist, L. E., Weiss, G. L., & Larsen, D. L. (1992). Health value and gender in predicting health protective behavior. *Women and Health*, 19(2/3), 69-85.
- Lubitz, J., Cai, L., Kramarow, E., & Lentzner, H. (2003). Health, life expectancy, and health care spending among the elderly. *The New England Journal of Medicine*, 349(11), 1048-1055.
- Lucas, F. L., DeLorenzo, M. A., Siewers, A. E., & Wennberg, D. E. (2006). Temporal trends in the utilization of diagnostic testing and treatments for cardiovascular disease in the United States, 1993-2001. *Circulation*, 113, 374-379.
- Macintyre, S., Ford, G., & Hunt, K. (1999). Do women over-report morbidity? Men's and women's responses to structured prompting on a standard question on long-standing illness. *Social Science & Medicine*, 48, 89-98.
- Macintyre, S., Hunt, K., & Sweeting, H. (1996). Gender differences in health: Are things really as simple as they seem?. *Social Science & Medicine*, 42, 617-624.
- Madigan, F. C. (1957). Are sex mortality differentials biologically caused? *Milbank Memorial Fund Quarterly*, 21, 202.
- Marks, N. F. (1996). Socioeconomic status, gender, and health at midlife: Evidence from the Wisconsin Longitudinal Study. *Research in the Sociology of Health Care*, 13A, 135-152.
- Marshall, A. A., Smith, S. W., & McKeon, J. K. (1995). Persuading low-income women to engage in mammography screening: Source, message, and channel preferences. *Health Communications*, 7, 283-299.
- Matthews, S., Manor, O., & Power, C. (1999). Social inequalities in health: Are there gender differences?. *Social Science & Medicine*, 48, 49-60.
- McClelland, J. W., Demark-Wahnefried, W., Mustian, R. D., Cowan, A. T., & Campbell, M. K. (1998). Fruit and vegetable consumption of rural African Americans: Baseline survey results of the Black Churches United for Better Health 5 A Day Project. *Nutrition and Cancer*, 30(2), 148-157.

- McDonough, P., & Walters, V. (2001). Gender and health: Reassessing patterns and explanations. *Social Science & Medicine*, 52, 547-559.
- Meichenbaum, D., & Turk, D. C. (1987). *Facilitating treatment adherence: A practitioner's guidebook*. New York: Plenum.
- Merrill, S. S., Seeman, T. E., Kasl, S. V., & Berkman, L. F. (1997). Gender differences in the comparison of self-reported disability and performance measures. *Journal of Gerontology*, 52A(1), M19-M26.
- Miller, B. (1990). Gender differences in spouse caregiver strain: Socialization and role explanations. *Journal of Marriage and Family*, 52(2), 311-321.
- Miller, B., & Cafasso, L. (1992). Gender differences in caregiving: Fact or artifact? *The Gerontologist*, 32(4), 498-507.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*, 40, 120-123.
- Nathanson, C. A. (1977). Sex, illness, and medical care: A review of data, theory, and method. *Social Science & Medicine*, 11, 13-25.
- Nebeling, L. ., Forman, M. R., Graubard, B. I., & Snyder, R. A. (1997). The impact of lifestyle characteristics on carotenoid intake in the United States: The 1987 National Health Interview Survey. *American Journal of Public Health*, 87(2), 268-271.
- Neel, J. V. (1990). Toward an explanation of the human sex ratio. In M.G. Ory & H. R. Warner (Eds.), *Gender, health, and longevity: Multidisciplinary perspectives* (pp. 57-72). New York: Spring Publishing Company.
- Newman, A. B., & Brach, J. S. (2001). Gender gap in longevity and disability in older persons. *Epidemiologic Reviews*, 23(2), 343-350.
- Nicklett, E. J., & Liang, J. (2010). Diabetes-related support, regimen adherence, and health decline among older adults. *Journal of Gerontology*, 65B(3), 390-399.
- Noelker, L. S., & Wallace, R. W., (1985). The organization of family care for the impaired elderly. *Journal of Family Issues*, 6, 23-44.
- O'Brien, M. K., Betrie, K., & Raeburn, J. (1992). Adherence to medication regimens: Updating a complex medical issue. *Medical Care Review*, 49(4), 435-454.
- Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States. *The Journal of the American Medical Association*, 295(13), 1549-1555.
- Oleckno, W. A. & Blacconiere, M. J. (1990). Wellness of college students and differences by gender, race, and class standing. *College Student Journal*, 24(4), 421-429.

- Oppenheim, M. (1994). *The man's health book*. Englewood Cliffs, NJ: Prentice Hall.
- Ory, M. G., & Warner, H. R. (Eds.). (1990). *Gender, health, and longevity: Multidisciplinary perspectives*. New York: Springer Publishing Company.
- Pascale, P. J., & Evans, W. J. (1993). Gender differences and similarities in patterns of drug use and attitudes of high school students. *Journal of Drug Education, 23*(1), 105-116.
- Pinquart, M., & Sorensen, S. (2006). Gender differences in caregiver stressors, social resources, and health: An updated meta-analysis. *Journal of Gerontology, 61B*(1), P33-P45.
- Pirraglia, P. A., Bishop, D., Herman, D. S., Trisvan, E., Lopez, R. A., Torgersen, C. S., Van Hopf, A. M., Anderson, B. J., Miller, I., & Stein, M. (2005). Caregiver burden and depression among informal caregivers of HIV-infected individuals. *Journal of Gen Intern Med, 20*, 510-514.
- Prohaska, T. R., Leventhal, E. A., Leventhal, H., & Keller, M. L. (1985). Health practices and illness cognition in young, middle aged and elderly adults. *Journal of Gerontology, 40*, 569-578.
- Rabe-Hesketh, S., & Skrondal, A. (2005, 2008). *Multilevel and Longitudinal modeling using Stata*. College Station, TX: Stata Press.
- Rakowski, W. (1986). Personal health practices, health status, and expected control over future health. *Journal of Community Health, 11*(3), 189-203.
- RAND. (February 2008). HRS Data, Version H. Produced by the RAND Center for the Study of Aging, with funding from the National Institute on Aging and the Social Security Administration. Santa Monica, CA
- Rathore, S. S., Berger, A. K., Weinfurt, K. P., Feinleib, J., Oetgen, W. J., Gersh, B. J., et al. (2000). Race, sex, poverty, and the medical treatment of acute myocardial infarction in the elderly. *Circulation, 102*, 642-648.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and data analysis methods* (2nd Edition). Thousand Oaks, CA: Sage.
- Rieker, P. P., & Bird, C. E. (2005). Rethinking gender differences in health: Why we need to integrate social and biological perspectives. *Journal of Gerontology, 60B*(Special Issue II), 40-47.
- Roberts, C. S., Cox, C. E., Shannon, V. J., & Wells, N. I., (1994). A closer look at social support as a moderator of stress in breast cancer. *Health & Social Work, 19*, 157-164.
- Robins, L. N., Helzer, J. E., Weissman, M. M., Orvaschel, H., Gruenberg, E., Burke, J. D., & Regier, D. A. (1984). Lifetime prevalence of specific psychiatric disorders in three sites. *Archives of General Psychiatry, 41*, 949-958.

- Ruberman, W., Weinblatt, E., Goldberg, J. D., & Chaudhary, B. S. (1984). Psychosocial influences on mortality after myocardial infarction. *New England Journal of Medicine*, *311*, 52-559.
- Savage, S., & Bailey, S. (2004). The impact of caring on caregivers__mental health: A review of the literature. *Australian Health Review*, *27*(1), 111-117.
- Schoenbach, V. J., Kaplan, B. H., Fredman, L., & Kleinbaum, D. G. (1986). Social ties and mortality in Evans County, Georgia. *American Journal of Epidemiology*, *123*(4), 577-591.
- Schofield, H., Bloch, S., Herrman, H., Murphy, B., Nankervis, J., Singh, B. (1998). *Family caregivers. Disability, illness, and aging*. Allen & Unwin, St. Leonards, NSW.
- Schone, B. S., & Weinick, R. M. (1998). Health-related behaviors and the benefits of marriage for elderly persons. *The Gerontologist*, *38*(5), 618.
- Schultz, R. A., O'Brien, T., Bookwala, J., & Fleissner, K. (1995). Psychiatric and physical morbidity effects of dementia caregiving: Prevalence, correlates, and causes. *The Gerontologist*, *35*(6), 771-791.
- Schulz, A. J., Israel, B. A., Zenk, S. N., Parker, E. A., Lichtenstein, R., Shellman-Weir, S., & Klem, L. (2006). Psychosocial stress and social support as mediators of relationships between income, length of residence and depressive symptoms among African American women on Detroit's eastside. *Social Science & Medicine*, *62*, 510-522.
- Seeman, T. E. (1996). Social ties and health: The benefits of social integration. *Annals of Epidemiology*, *6*(5), 442-451.
- Seeman, T. E., Kaplan, G. A., Knudsen, L., Cohen, R., & Guralnik, J. (1987). Social network ties and mortality among the elderly in the Alameda County Study. *American Journal of Epidemiology*, *126*, 714-723.
- Seeman, T. E., Lusignolo, T. M., Alpert, M., & Berkman, L. (2001). Social relationships, social support, and patterns of cognitive aging in healthy, high-functioning older adults: MacArthur Studies of Successful Aging. *Health Psychology*, *20*(4), 243-255.
- Sen, G., George, A., & Ostlin, P. (2002). *Engendering International Health: The Challenge of Equity*. Cambridge, MA: MIT Press.
- Serdula, M. K., Coates, R. J., Byers, T., Simoes, E., Mokdad, A. H., & Subar, A. F. (1995). Fruit and vegetable intake among adults in 16 states: Results of a brief telephone survey. *American Journal of Public Health*, *85*(2), 236-239.
- Sherman, S., Ward, R., & LaGory, M. (1988). Women as caregivers of the elderly: Instrumental and expressive support. *Social Work*, *33*, 164-167.

- Sherrod, D. (1987). The bonds of men: Problems and possibilities in close male relationships. In H. Brod (Ed.), *The making of masculinities: The new men's studies* (pp. 213-239). Winchester, MA: Allen and Unwin.
- Shi, L. (1998). Sociodemographic characteristics and individual health behaviors. *Southern Medical Journal, 91*(10), 933-941.
- Shye, D., Mullooly, J. P., Freeborn, D. K., & Pope, C. R. (1995). Gender differences in the relationship between social network support and mortality: A longitudinal study of an elderly cohort. *Social Science and Medicine, 41*(7), 935-947.
- Spiegel, D., Bloom, J. R., Kraemer, H. C., & Gottheil, E. (1989). Effect of psychosocial treatment of survival of patients with metastatic breast cancer. *Lancet 2*(8668), 888-891.
- Spitze, G., & Logan, J. (1989). Gender differences in family support: Is there a payoff? *The Gerontologist, 29*(1), 108-113.
- Tabenkin, H., Goodwin, M. A., Zyzanski, S. J., Stange, K. C., & Medalie, J. H. (2004). Gender differences in time spent during direct observation of doctor-patient encounters. *Journal of Women's Health, 13*(3), 341-349.
- Thoits, P. A. (1982). Life stress, social support, and psychological vulnerability: Epidemiological considerations. *Journal of Community Psychology, 10*, 341-362.
- Thoits, P. A. (1987). Gender and marital status differences in control and distress: Common stress versus unique stress explanations. *Journal of Health and Social Behavior, 28*, 7-22.
- Tolleson-Rinehart, S. (2005). "Women get sicker; men die quicker": Gender, health politics, and health policy. In S. Tolleson-Rinehart & J. J. Joephson (Eds.). *Gender and American politics: Women, men, and the political process*. New York: Sharpe.
- Uchino, B. N. (2004). *Social support and physical health outcomes: Understanding the health consequences of our relationships*. New Haven, CT: Yale University Press.
- Umberson, D. (1987). Family status and health behaviors: Social control as a dimension of social integration. *Journal of Health and Social Behavior, 28*(3), 306-319.
- Umberson, D. (1992). Gender, marital status and the social control of health behavior. *Social Science and Medicine, 34*(8), 907-917.
- Umberson, D., Chen, M. D., House, J. S., Hopkins, K., & Slaten, E. (1996). Gender differences in relationships and psychological well-being. *American Sociological Review, 61*, 837-857.
- Vacarrino, V., Krumholz, H. M., Yarzebski, J., Gore, J. M., & Goldberg, R. J. (2001). Sex differences in 2-year mortality after hospital discharge for myocardial infarction. *Annals of Internal Medicine, 134*, 173-181.

- Van Horn, L. V., Ballew, C., Liu, K., Ruth, K., McDonald, A., Hilner, J. E., Burke, G. L., Savage, P. J., Bragg, C., Caan, B., Jacobs, D., Slattery, M., & Sidney, S. (1991). Diet, body size, and plasma lipids-lipoproteins in young adults: Differences by race and sex. *American Journal of Epidemiology*, *133*(1), 9-23.
- Verbrugge, L. M. (1975). Morbidity and mortality in the United states: A riddle of the sexes. Unpublished paper. Department of Social Relations and Center for Metropolitan Planning and Research, Johns Hopkins University.
- Verbrugge, L. M. (1985). Gender and health: An update on hypotheses and evidence. *Journal of Health and Social Behavior*, *26*, 156-182.
- Verbrugge, L. M. (1990). The twain meet: Empirical explanations of sex differences in health and mortality. In M. G. Ory & H. R. Warner (Eds.), *Gender, health, and longevity: Multidisciplinary perspectives* (pp. 159-194). New York: Springer.
- Verbrugge, L., Wingard, D. L., (1987). Sex differentials in health and mortality. *Women and Health*, *12*(2), 103-145.
- Vogt, T. M., Mullooly, J. P., Ernst, D., Pope, C. R., & Hollis, J. F. (1992). Social networks as predictors of ischemic heart disease, cancer, stroke and hypertension: Incidence, survival and mortality. *Journal of Clinical Epidemiology*, *45*(6), 659-666.
- Waite, L. J. (1995). Does marriage matter? *Demography*, *32*(4), 483-507.
- Waldron, I. (1988). Gender and health-related behavior. In D. S. Gochman (Ed.), *Health behavior: Emergerging research perspectives* (pp. 193-208). New York: Plenum.
- Waldron, I., & Johnston, S. (1976). Why do women live longer than men? Part II. *Journal of Human Stress*, *2*(2) 19-30.
- Walker, S. N., Volkan, K., Sechrist, K. R., & Pender, N. J. (1988). Health promoting lifestyles of older adults: Comparisons with young and middle aged adults, correlates and patterns. *Advances in Nursing Science*, *11*, 76-90.
- Weiss, C. O., Gonzalez, H. M., Kabeto, M. U., & Langa, K. M. (2005). Differences in the amount of informal care received by non-Hispanic whites and Latinos in a nationally representative sample of older Americans. *Journal of the American Geriatric Society*, *53*: 146-151.
- Weissfeld, J. L., Kirsch, J. P., & Brooke, B. M. (1990). Health beliefs in a population: The Michigan Blood Pressure Survey. *Health Education Quarterly*, *17*(2), 141-155.
- Wellmann, B., & Wortley, S. (1990). Different strokes from different folks: Communities ties and social support. *American Journal of Sociology*, *96*(3), 558-588.
- West, B. T., Welch, K. B., & Galecki. T. (2007). Linear mixed models: A practical guide using statistical software. New York: Chapman & Hall.

- Westmaas, J. L., Wild, T. C., & Ferrence, R. (2002). Effects of gender in social control of smoking cessation. *Health Psychology, 21*(4), 368-376.
- Wexler, D. J., Nathan, D. M., Grant, R. W., Cagliero, E., & Meigs, J. B. (2005). Sex disparities in treatment of cardiac risk factors in patients with type 2 diabetes. *Diabetes Care, 28*(3), 514-520.
- Wheaton, B. (1990). Life transitions, role histories, and mental health. *American Sociological Review, 55*, 209-223.
- White, A. A., & Klimis-Tavantzis, D. J. (1992). Dietary risk assessment for cardiovascular disease among central Main adolescents. *Journal of School Health, 62*(9), 428-432.
- Wills, T. A., & Filer, M. (2001). Social networks and social support. In A. Baum, T. A. Revenson & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 209-234). Mahwah, NH: Erlbaum.
- Wingard, D. L., Cohn, B. A., Kaplan, G. A., Cirillo, P. M., & Cohen, R. D. (1989). Sex differentials in morbidity and mortality risks examined by age and cause in the same cohort." *American Journal of Epidemiology, 130*(3), 601-610.
- Wu, J. H., Haan, M. N., Liang, J., Ghosh, D., Gonzalez, H. M., & Herman, W. H. (2003). Diabetes as a predictor of change in functional status among older Mexican Americans: A population-based cohort study. *Diabetes Care, 26*, 314-319.

Chapter 5

Conclusion

Overall Findings

In general, this dissertation offers support to the health disparities literature: health inequalities are pervasive according to race/ethnicity, socioeconomic status, and gender among older adults with diabetes and these inequalities become more pronounced over time and as individuals age. Findings related to cumulative advantage and disadvantage offered support to life course theory, which largely guided this research. Findings related to the mechanisms of social support and health and illness behavior offer support to the Health Decision Model. These studies also found that these disparities interact with health processes (such as adherence and other health behaviors) and social factors (such as the provision and receipt of social support and tangible forms of care), which in some cases exacerbate disparities and in other cases provide protection against further decline of vulnerable populations. This research contributes to the field by elucidating how these disparities grow over time and which characteristics are risk or protective factors for members of sociodemographic groups.

A number of unique findings also arose in the three substantive dissertation chapters. In Chapter 2, I found that while disease-related support is not necessarily protective against health decline in the short term, it is positively associated with adherence, which was (to our knowledge) an original finding. In Chapter 3, I entered a

highly contested debate as to whether or not socioeconomic status and race/ethnicity independently predict health. I found that they are indeed both independent predictors, but that race/ethnicity and socioeconomic status effects also operate in conjunction with one another to exacerbate health disparities over time. Finally, in Chapter 3, I found that women generally have sharper rates of functional decline than do men (as previous research has suggested), but if you take the interactive relationships between health and illness behavior and social ties together, the gender situation reverses. I also found that marriage is significantly protective for women but not for men against functional decline. The qualitative analysis also provided new interpretations of relationships previously analyzed quantitatively. Finally, these studies were conducted using longitudinal data on samples of older adults with type 2 diabetes, a population that is growing in incidence and prevalence.

These findings also raise additional questions: What implications can be made for policy based on the findings from these studies? What research is necessary to further clarify and address these relationships? What comes next? I will integrate the concept of heterogeneous experiences of chronic illness to address these questions.

Experiences of Chronic Illness

As we discuss how individual experiences of illness interact with different individual-, community-, and organization-level factors, we must distinguish between ‘individual experiences’ in general *versus* ‘experiences in individual lives’. What the chronically ill ‘tend to’ experience can differ greatly by individual factors. For example, Freidson (1988) argued that the likelihood that individuals will perceive themselves as ill

(and will seek care) is contingent upon their perception of the medical system, their meaning of illness, attitudes, and lay referral systems. Further, social position can determine access to resources early in life (to prevent chronic illness) and later in life (to more successfully manage chronic illness), which can influence subsequent experiences (James et al., 2006). In short, events that occur throughout the life course cannot be divorced from the analysis of how well individuals manage chronic health problems and optimize health outcomes.

Chronic illness intersects with psychological well-being, overall health, and social systems, as it intersects with social life, change, and the causes and consequences of human behavior. Chronic illness experiences do not exist in a vacuum—rather, they are indicative of behavior patterns and life transitions. Further, as suggested by the results in Chapter 4, individuals with chronic illness interact with one another, their support system, and practitioners and health/social institutions (each with norms, attitudes, and policies). Further, chronic illness experiences vary throughout historical *time*, time in an individual's health biography and time in historical shifts in the causes and consequences of illness and approaches to care and cure. These individual experiences cut across individual, community, and system-level factors.

Research stemming from the sociological and anthropological traditions has documented common *individual* experiences felt by those trying to manage a chronic illness: (a) restructuring of time; (b) new forms of 'work' managing the disease; and (c) an altered identity. The onset, progression, and management of chronic illness are viewed by some scholars as a 'biological disruption', requiring individuals to re-channel human and financial capital (Bury, 1982). In the study *Good Days, Bad Days*, Kathy Charmaz

(1993) analyzes how chronic illness alters time from the perspective of the patient. She finds that chronic illness is a burdening experience, restructuring daily routines into regimens and readiness to respond to acute episodes emerging from the chronic illness. Through the time and effort demanded by the regimen—as well as attending to functional and debilitating outcomes—lives of individuals are recast and changed. In an historical biography of the transformation of type I diabetes mellitus from an acute to a chronic illness, Feudtner (2003) documented how tending to the chronic illness became a job in and of itself—whereby complicated regimens can lead to ‘ritualized work’—work in optimizing daily outcomes, monitoring, adjusting one’s diet and medications, handling symptoms, and working with providers and health/social systems. Additional research has found that individuals face a re-definition of selves through the process of diagnosis, management, and progression of chronic illness, as they confront uncertainty and autonomy and morality are challenged (Bury, 1982; Frank, 2004; Weitz, 2001). Throughout these changes—changes in time, changes in work, and changes in self—chronic illness transforms individuals, a transformation linked with disease experiences and life events (Paterson, 1999; Williams, 2000).

As discussed in Chapter 4, the experience of illness also intersects with community-level characteristics. Such community-level include (a) illness collectivities; (b) network support; and (c) social perceptions and framings of illnesses. Illness collectivities shape the processes by which individuals conceptualize, contextualize, and respond to illness in their lives, as has been shown in studies addressing disabilities, fibromyalgia, and breast cancer (Anspach, 1979; Barker, 2004; Klawiter, 2001). The network of support from families and friends has been found to be a ‘double-edged’

sword in influencing illness experiences—while individuals may fare better with support and care-giving, this might strain relationships and caregiver well-being (Fisher & Weihs, 2000; Ohman & Soderberg, 2004; Patterson & Garwick, 1994; Veltman et al, 2002); further, interactions and relationships change as individuals transform through chronic illness (Bury, 1982; Charmaz, 1993). Finally, the social context in which the illness is framed can strongly shape the experience of illness, such as the extent to which an illness is stigmatized (Goffman, 1963) and to which it is attributable to the bearer's responsibility, is unalterable, or degenerative (Herek, 2004). The experience can also be differently perceived as a social problem by society, which influences resources devoted to that illness (Blumer, 1971).

Finally, the individual experience of illness calls for considering patient interactions with providers, care delivery systems, and social agencies. In general, the ease or difficulty with which individuals are able to receive treatment, arrange for payment, and access health care services (including the appropriateness of care and patient-provider interactions) are key predictors for how well individuals manage chronic health problems and optimize health outcomes.

Policy Priorities

The growing burden of chronic illness—particularly among disadvantaged populations—is perhaps the largest current policy concern facing the public health community. Chronic illness is rooted and exacerbated by systems of social inequality, which can be considered a fundamental causes of illness (Link & Phelan, 1995), which

explains chronic illness onset and outcomes disparities by race/ethnicity and socioeconomic status throughout the life course, particularly for preventable conditions (House et al., 2000; Phelan et al., 2004; Williams, 1990). I will suggest a two-pronged policy intervention strategy to reduce the burden of chronic illness on society: (1) Policy intervention strategy to prevent chronic illness earlier in the life course; (2) Policy intervention strategy to more efficiently treat chronic illnesses. While the targeted policies proposed here are ‘midstream’ and do not focus on the root of social inequality, these interventions are contextualized within the larger social structure (within the life course and the social environment) and are aimed to prevent the onset of chronic illness and to improve outcomes.

Prevention of Chronic Illness

Although this dissertation focused primarily on the *prevalence* rather than the *incidence* of chronic disease, policies aiming to reduce health inequalities in chronic disease should focus upstream at health determinants and how social and behavioral risk factors vary by group. Chronic illnesses vary greatly by the degree to which they are behaviorally versus genetically determined, by how disruptive regimen components are on individuals’ lives, and by the extent to which regimen adherence can influence long-term outcomes and prognosis. As discussed throughout this dissertation, there is also tremendous group- and individual-level variability in the experiences and outcomes of chronic illness.

Despite these differences, however, there are clear trends regarding the public health burden of chronic illness in the United States. A recent study by Mokdad et al.

(2004) found that the leading causes of death in 2000 were tobacco (435,000 deaths; 18.1% of total US deaths), poor diet/lack of physical activity (400,000 deaths, 16.6%), and consumption of alcohol (85,000 deaths, 3.5%). These cases were followed by much less prevalent, more acute causes of death including microbial and toxic agents, motor vehicle crashes, firearm incidents, sexual behaviors, and illicit drug use (Mokdad et al., 2004). Therefore, deaths in the United States are increasingly attributed to chronic conditions that are preventable. As the proportion of Americans with chronic illnesses increases (particularly those with hypertension, heart disease, and diabetes), the health care costs associated with preventable chronic illness is likely to increase as well. Policy action is required to promote the prevention and treatment obesity-related chronic illness taking the life-course perspective into consideration.

From Acute to Chronic Illnesses

We must shift the focus of treatment and delivery systems from acute to chronic illnesses. More resources need to be diverted to providing care for the chronically ill with the emphasis of maintaining health and well-being in a comprehensive manner. Systems of care need to be less fragmented and more navigable for the chronically ill. Financing services must be better coordinated, organized, and eligibility/coverage standards should be more transparent within and across systems (Anderson & Knickman, 2001). This system restructuring requires not only improved coordination of systems of care (Wagner et al., 2001), but also a shift in financing from the health to the social sectors (Hurowitz, 1993). The linking of patients, providers, and communities to promote health and welfare services among the chronically ill provides guide for system restructuring. As the aging population increasingly develops complex chronic illness and comorbidities,

the goal of health care should no longer be to detect and treat by any means necessary and, given demographic trends in the population, this will no longer be feasible. Rather, policy should focus on increasing the comfort, efficiency, and integration of systems to maximize health outcomes and experiences among the chronically ill. In many cases this will include a shift from acute-focused to palliative care and the provision of social services outside of the medical setting.

Drawing on quantitative and qualitative research, community based integrative centers tend to be effective if they meet a number of patient needs. A concrete, bottom-up example of this shift is the establishment of Community Chronic Care Clinics (staffed by geriatric care teams including geriatricians, general practitioners, nurse practitioners, social workers, and community volunteers), whereby those with chronic illnesses can receive the integrative care that they need. These services will cross-cut medical needs (regular check-ups, administering medication) and social needs (community among chronically ill, wellness programs for optimal maintenance and outcomes, providing healthful meals). The social needs should also expand to integrate social ties with physical activity and healthful eating. Eventually, the integrative systems will expand to provide the majority of medical and social services for Medicare and Medicaid enrollees with chronic illnesses, with the possibility of expanding to other beneficiaries. Referrals will be provided for specialist services. This system will be primarily funded through Medicare and Medicaid dollars (as well as reimbursements from other third-party providers). Additional services (such as activities and meals) can be provided at cost (or on a volunteer basis) to members of the clinics. Federal funding will be required for the

initial establishment of such centers and services, likely to be first administrative as part of a pilot program.

In a system that provides health coverage via Medicare to almost all older adults, the waste caused through unnecessary diagnostic tests, procedures, and duplicative equipment literally taxes the system. The burden of handling multiple payment systems, non-collaborating providers, and system that is difficult to navigate, however, is currently carried by the growing proportion of people in the US with chronic illnesses. Instead of focusing on public-funded profits for inefficient and fragmented systems, it is high time that public health dollars be redistributed from profit-driven channels to those that improve quality of life and health outcomes for a growing portion of the population. These can provide opportunities for individuals to form supportive friendships and networks in their communities which, with the combination of health factors, were shown (Chapter 4) to effectively prevent further health and disability decline.

In general, individuals with chronic illness have numerous objectives, including maximizing health outcomes and functional status, minimizing symptoms of distress, and managing the stressors of pain and disability—as written by Grumbach, ~~In~~ chronic illness, care of the whole person is paramount” (2003, p. 5). It will be increasingly necessary to balance these individual goals with the demands they make—demands on the individual, on members of their support system, on communities and health organizations, and on public health priorities. The balancing of these goals and demands to optimize individual and societal priorities should be a guiding and overarching mission of the public health and policy community. The policies proposed suggest mechanisms to

address the burden of chronic illness: reducing the need and demand for health services in future generations and reducing costs for the provision of care.

Research Priorities

These findings raise numerous questions for additional research so that findings can be translated into concrete interventions, including in clinical and community settings. For example, patterns of health decline should be further mapped with other life events to better evaluate optimal points of intervention, which could vary by group membership. Significant research should be done in this area as the opportunity to enhance quality of life and reduce subsequent complications and healthcare costs is substantial. Further, the ways in which individuals (according to certain characteristics) utilize or do not utilize community-based interventions geared toward chronically ill populations would be useful for predicting which forms of interventions would be most appropriate. For example, community- or neighborhood level interventions geared toward providing blood glucose tests or diabetes friendly food might be good in theory, but might not be effective if those who need it most would not participate or could not leave their homes. Qualitative data is a helpful resource for providing information on some of the impediments to access or participation for such interventions.

The more immediate research steps I will take include analyses of the following:

- Multiple trajectories of diabetic outcomes using group-based trajectory analysis to illustrate the health and disability trajectories experienced by different social groups.

- The relationship between diabetes and other chronic illness on long-term health outcomes, including view of diabetes in the context of other chronic illness narratives (mixed-method analysis)
- The gendered impact of marriage and other statuses over time on populations with and without chronic illnesses (quantitative analysis)
- The relationship between neighborhood / community level factors and adherence (qualitative analysis)
- Socioeconomic status and conditions of discovery of diabetes (including prior knowledge of diabetes and resources to address it), relating to level of adherence and outcomes later in life (mixed method analysis)
- Patterns of social dislocation and social change on long-term health outcomes in a diabetic sample in greater Detroit (qualitative analysis)
- The positive and negative impacts of work on type 2 diabetes (mixed method analysis)
- Why people cheat: a gendered analysis of non-adherence to food and exercise in a diabetic regimen from a harm reduction perspective (qualitative analysis)

Together, this body of research will provide more detailed information about the processes and experiences through which individuals live with chronic illness. Further, the examination of how the interaction with other entities, including people, communities, agencies, healthcare providers, and their own histories—could provide insight regarding how individuals cope with, interact with, and contextualize their illness within their everyday lives.

References

- Anderson, G., & Knickman, J. R. (2001). Changing the chronic care system to meet people's needs. *Health Affairs*, 20(6), 146-160.
- Anspach, R. (1979). From stigma to identity politics: Political activism among the disabled and former mental patients. *Social Science and Medicine*, 13A 776-783.
- Barker, K. Self-Help literature and the making of an illness identity: The case of Fibromyalgia Syndrome (FMS). In P. Conrad (2004). *The Sociology of Health and Illness: Critical Perspectives*. 7th ed. New York: Worth Publishers, p. 133-149.
- Blumer, H. (1971). Social problems as collective behavior. *Social Problems*, 18(3), 298-305.
- Bury, M. (1982). Chronic illness as biographical disruption. *Sociology of Health & Illness*, 4(2), 167-182.
- Bury, M. (2001). Illness narratives: Fact or fiction? *Sociology of Health & Illness*, 23(3), 263.
- Charmaz, K. (1993). Good days, bad days: The self in chronic illness and time. New Brunswick, NJ: Rutgers University Press
- Feudtner, C. (2003). Bittersweet: Diabetes, insulin, and the transformation of illness. Chapel Hill, NC: The University of North Carolina Press.
- Fisher, L., & Weihs, K. L. (2000). Can addressing family relationships improve outcomes in chronic illness? Report of the National Working Group on Family-Based Interventions in Chronic Disease. *Journal of Family Practice*, 49, 561-566.
- Frank, A. W. The remission society. In P. Conrad (2004): *The Sociology of Health and Illness: Critical Perspectives*. 7th ed. New York: Worth Publishers, 163-166.
- Freidson, E. (1988). Profession of medicine: A study of the sociology of applied knowledge. Chicago: University of Chicago Press.
- Goffman, E. (1963). Stigma: Notes on the Management of Spoiled Identity. New York: Simon & Schuster.
- Grumbach, K. (2003). Chronic illness, comorbidities, and the need for medical generalism. *Annals of Family Medicine*, 1(1), 4-7.
- Herek, G. M. AIDS and stigma. In P. Conrad (2004). *The Sociology of Health and Illness: Critical Perspectives*. 7th ed. New York: Worth Publishers, 121-129.
- House, J. S., Lepkowski, J. M., Williams, D. R., Mero, R. P., Lantz, P. M., Robert, S. A., & Chen, J. (2000). Excess mortality among urban residents: How much, for whom and why? *AJPH*, 90(12), 1989-1994.

- Hurowitz, J. C. (1993). Toward a social policy for health. *NEJM*, 329(2), 130-133.
- James, S. A., Van Hoewyk, J. V., Belli, R. F., et al. (2006). Life-Course socioeconomic position and hypertension in African American men: The Pitt County study. *AJPH*, 96(5), 812-17.
- Klawiter, M. (2001). Racing for the Cure, Walking Women, and Toxic Touring: Mapping cultures of action. In P. Conrad. (2001). *The Sociology of Health and Illness: Critical Perspectives*. 6th ed. New York: Worth Publishers, 433-445
- Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*, 35, 80-94.
- Mokdad, A. H., et al. (2004). Actual causes of death in the United States. *JAMA*, 291(10), 1238-1445.
- Ohman, M., & Soderberg, S. (2004). The experiences of close relatives living with a person with serious chronic illness. *Qualitative Health Research*, 14(3), 396-410.
- Patterson, J. M., & Garwick, A. W. (1994). The impact of chronic illness on families: A family systems perspective. *Annals of Behavioral Medicine*, 16(2), 131-142.
- Phelan, J. C., Link, B. G., Diez Roux, A., Kawachi, I., & Levin, B. (2004). "Fundamental causes" of social inequalities in mortality: A test of the theory. *Journal of Health and Social Behavior*, 45(3), 254-285.
- Veltman, A., Cameron, J. I., Stewart, D. (2002). The experience of providing care to relatives with chronic mental illness. *Journal of Nervous & Mental Disease*, 190(2), 108-114.
- Wagner, E. H., Austin, B. T., Davis, C., et al. (2001). Improving chronic illness care: Translating evidence into action. *Health Affairs*, 20, 64-78.
- Weitz, R. Uncertainty and the lives of persons with AIDS. In P. Conrad (2001). *The Sociology of Health and Illness: Critical Perspectives*. 6th ed. New York: Worth Publishers, 136-46.
- Williams, D. R. (1990). Socioeconomic differentials in health: A review and redirection. *Social Psychology Quarterly*, 53(2), 31-99.
- Williams, S. (2000). Chronic illness as a biographical disruption or biographical disruption as chronic illness? Reflections on a core concept. *Sociology of Health & Illness*, 22(1), 40.