A quantitative study of the relationships between activity limitation and participation restriction among older people with vision impairment and comorbid conditions

By

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A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Counselor Education
in the Department of Counseling and Educational Psychology

Mississippi State, Mississippi

May 2015

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Pages in Study: 187

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The purpose of the study was to investigate the prevalence and effects of vision impairment co-existing with other comorbid conditions. Utilizing the 2008 National Health Interview Survey, the most recent nationally representative data including expanded vision, health conditions, and activity questions, this study examined the effect of vision impairment co-existing with selected comorbid conditions among non-institutionalized older adults age ≥ 55 years. Specifically, this study compared 4 groups: (a) older adults with neither vison impairment nor comorbid conditions, (b) older adults with vision impairment only, (c) older adults with comorbid conditions only, and (d) older adults with both vision impairment and each of the comorbid conditions to examine the prevalence and effect of vision impairment and comorbid conditions on selected mobility and vision activity limitations, and participation restrictions. Using complex sample techniques to conduct frequency analyses and logistic regression procedures, this

study compared these groups of older adults to document the likelihood of experiencing mobility and vision activity limitations, and participatory restrictions.

These results suggest that older adults reporting vision impairments are a heterogeneous population, overwhelmingly use corrective lenses, and experience substantial mobility and vision activity limitations, and participatory restrictions; however, relatively few report using low vision aids or rehabilitation services. In addition, these results revealed, even when controlling for age, sex, race/ethnicity, marital status, region of residence, and health status, older adults with vision impairment and any of the selected comorbid conditions were statistically significantly more likely to report mobility and vision activity limitations, and participation restrictions. Moreover, when comparing older adults reporting vision impairment co-existing with comorbid conditions older adults reporting either vision impairment only or a comorbid condition only, the results suggest vision impairment had the largest statistically significant effect on the likelihood of mobility or vision activity limitations, or participatory restriction in 29 of the 44 logistic regression analyses. These findings are significant as vision impairment is framed as a public health concern, and can inform improvements in programs and services for older adults. Finally, these findings highlight the need for expanded research examining the effect of specific eye diseases and comorbid conditions among older adults.

DEDICATION

This dissertation is dedicated to my wife, family, teachers, and friends who have supported me through this process and my entire life. So many of you have had a substantial effect on the opportunities afforded me all my life, but especially so through this journey. I am most fortunate to have friends who have walked with my family and me through some dark times, and you have been a constant reminder that I could finish this journey. My teachers at all stops through my academic programs have been so faithful to create quality-learning environments. My daughter, Jessica Smith, son, Trey Sansing, son-in-law, Justin Smith, and grandson, Luke Smith often allowed my academic needs being placed ahead of their needs, and I am eternally grateful for your grace, patience, and continued encouragement. Last but not least, to my wife Ann Sansing who has supported and loved me unconditionally, and believed I could complete this journey; you are the difference maker in my life. I thank each of you more than I can communicate.

ACKNOWLEDGEMENTS

I would like to extend my heartfelt acknowledgements and deepest gratitude to my dissertation committee: my major professor, Dr. Charles Palmer for his unconditional acceptance, support, guidance, and encouragement throughout my program and for serving as the ultimate example of an effective professor and counselor; Dr. Joan Looby who facilitated unique opportunities allowing me to accomplish everything I wanted through my Master's and Doctoral programs, and whose multicultural classes were pivotal in shaping my counseling approaches; Dr. April Heielt for expanding my teaching and classroom skills that have molded my current techniques; Dr. Rebecca Goldberg for sharing her counseling interests, and opening her doors and being willing to guide me through this process; and Dr. John Crews who first opened my mind to research with complex, multi-stage survey data and guiding me into the public health aspects of vision impairment.

A special thanks to the staff of the National Research and Training Center on Blindness and Low Vision as it was there where my mind was opened to the world of disability research and program evaluation. Additionally, there have been many mentors in my secondary academic program who taught me demography skills that have opened so many doors, and I thank Dr. Lynne Cossman, Dr. Troy Blanchard, and Dr. Frank Howell. I could have never accomplished this process without the skills each of you taught me. Finally, there have been many new mentors in my life who have served as

final encouragers in this journey, and I give them a heartfelt thanks for their support: Dr. Virginia Young, Ms. Gina Thompson, and Dr. Thomas Ware.

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CHAPTER I

INTRODUCTION

The U.S. is experiencing unprecedented demographic shifts as increasing numbers of people enter old age and experience increasing longevity. In 1900, only 3 million people (4.1% of the population) were aged 65 years and over, and average life expectancy was about 47 years. By 2010, 40.2 million Americans (13.1% of the population) were age 65 year or over, and life expectancy had increased to approximately 78 years. By 2050, the aging population is expected to almost double to 83.7 million and comprise about 20% of the population, with life expectancy expected to reach 83 years (Ortman, Velkoff, & Hogan. 2014).

Coupled with these demographic shifts are debates about social consequences of this population increase, including rates of disability, overall health status, acute and chronic conditions, as well as quality of life (Cutler, 2001). In the late 1980s, researchers (Verbrugge, Lepkowski, & Imanaka, 1989) conducted pioneering work in comorbidity, aging, and disability research, recognizing that aging and disability represent complex, multi-faceted concepts that may be central to an older adult's self-identity. Moreover, Verbrugge et al. (1989) contend that multiple chronic conditions complicate many life activities and increase the likelihood of accidents and/or limitations in later life. Therefore, the increasing numbers of older people combined with the multiple consequences of aging draw these dynamics into the arena of population health (Centers for Disease Control and Prevention (CDC, 2012). The circumstances of older people with vision impairment serve as an exemplary model of a rapidly increasing population that experiences the effects of age-related multiple chronic conditions that threaten independence and quality of life. Thus, the purpose of this investigation is to better understand the prevalence and effects of comorbid conditions among older people with vision impairment and to inform policies and practices that may improve their lives (Berg & Cassells, 1992).

Since the 1960s, investigators have struggled to establish robust conceptual frameworks and useful case definitions to better understand the experience of disability. Early work by Lawton and Brody (1969), established the concept of Activities of Daily Living (ADLs) which were used primarily in aging research. Subsequently, they developed the concept of Instrumental Activities of Daily Living (IADLs). Prior to this work, Nagi (1964) identified domains of the disablement process. Beginning in 1970, the World Health Organization proposed multiple frameworks to characterize human function and the effect of disability that culminated in the 2001 release of *The International Classification of Functioning, Disability and Health* (ICF; World Health Organization, 2002). In 2007, the Institute of Medicine's *The Future of Disability in America* argued for adoption of the ICF model as the standard for disability research in the US (Field & Jette, 2007). Berg and Casells (1992) argued that the lack of clear organizational frameworks could leave America's health care unprepared to address the needs of the aging population. These researchers contended that disability must be understood and addressed as a multi-faceted dynamic. Later, Field and Jette (2007) added that disability involves at least two fundamental concepts that must be operationalized within these concepts. First, disability is dimensional, that is, the experience affects multiple domains of a person's life, it is interactive (not linear), has multiple outcomes, and may be defined by the fit between the person and the environment. These elements are captured in the ICF. Second, disability is dynamic; that is, disability and the dimensions of disability are subject to change. People can improve in health or skills performance, or they can decline. Changes in the environment (e.g., a handrail in a stairway or improved transportation) may improve function and social participation. Among older people, sustaining health and function—preventing decline—may be positive outcomes. Disability research, especially as it affects older people with vision impairment, can attend to the malleable characteristics that define the person and his or her environment.

The prevalence and effects of multiple chronic conditions among older people represent a range of malleable characteristics. For example, Verbrugge et al. (1989) used the 1984 Supplement of Aging (SOA) to examine the potential linear occurrence of 78 potential combinations of 13 chronic conditions occurring in adults over age 55 years and concluded that the two most frequently reported chronic conditions were arthritis (43.7%) and high blood pressure (40.5%); however, when sensory conditions or impairments were accounted for collectively, 54.1% reported a sensory/impairment or condition, which included hearing impairment (28.1%), vision condition or disease (15.0%), or vision impairment (11.0%). Thus, sensory impairment is one of the most frequently reported conditions among these adults. Likewise, 11 of the 20 leading pairs of chronic conditions included one of the sensory conditions, making sensory impairment a leading contributor to multiple comorbid conditions (MCCs) reported in later life. These researchers also investigated the potential impact of these comorbid conditions on individual functioning and concluded that while hip fractures were the least prevalent condition, they resulted in the second highest rank of impact. These researchers argued that future research must examine clusters of conditions that result in the most limiting outcomes in individuals' daily lives.

Fried, Bandeen-Roche, Kasper, and Guralnik (1999) conducted a similar examination among older women and found that interactions between specific diseases have substantial impacts on the occurrences of disability. Using multiple logistic regression techniques, these researchers analyzed data from a representative sample of 3,841 women aged 65 years and older and found that specific disease pairs were synergistically associated with various disabilities. Their findings suggest that some health condition combinations have greater combined effects. For example, arthritis and vision impairment were one of the more important pairs revealed in this investigation. The investigators concluded that their analyses provided the basis for additional hypotheses and future research directed toward the synergistic relationship of comorbid conditions and specific disabling conditions. Future investigations could translate into new strategies for disability prevention and minimizing the impact of comorbid conditions.

Researchers, administrators, and public health officials have long stated that vision impairment is one of the most significant disabilities among people age 18 and above (CDC, 2006, 2012; Flax, Golembiewski & McCaulley, 1993; Negrin, 1983; Rogers & Orr, 2000; The Lighthouse International, 1995). Specifically, vision impairment can affect a person's independence by limiting his/her ability to read, drive, perform common household tasks, and/or manage activities of daily living (Collins, 2006). Moreover, among adults age 55 years and over, vision impairment has been associated with higher prevalence rates of many chronic health conditions, premature death, falls, and injuries (Lee, Gomez-Martin, Lam, & Zheng, 2003).

Historically, attention to the relatively large number of people potentially affected by vision impairment and related eye conditions drew investigators to advocate for more rigorous research, prevention, and rehabilitation programs (Bergs & Cassells, 1992). While much early research focused on the increasing population of people with vision impairment, these investigations tended to treat this group as a static, homogenous population. More recent investigations have examined disparities that characterize the population of people with vision impairment. Disparities in age, sex, race, income, and education are commonly recognized (Zambelli-Weiner, Crews, & Friedman, 2012). Only recently have researchers come to realize that people with vision impairment have a disproportionate prevalence of chronic health conditions, and the effects of those chronic conditions are only now beginning to be understood (CDC, 2006, 2012; Crews, Jones, & Kim, 2006).

Current initiatives, largely advanced by the CDC (2006), are being launched to promote national and individual programs to address many of the public health concerns and individual consequences of vision impairment, comorbid conditions, functional limitations, and other health concerns along the life course. These initiatives involve promoting a public health perspective of vision health, advancing the objectives of Healthy People 2020, expanding existing vision research programs, and disseminating new knowledge of consequences of vision impairment (CDC, 2006; HHS, 2010).

These initiatives are hindered by historical approaches used to measure and document the impact of disability, especially in the later stages of the life course. Measures of ADLs and IADLs, introduced in the 1960s, have been used to estimate disability in population-based surveys (National Research Council, 2009). These measures grew from a need to operationalize functional status and disability rather than rely solely on self-perceived health or to employ disease as a proxy for function. ADLs, developed by Brody, characterize people's abilities to perform basic tasks of daily life including eating, dressing, and bathing, using the toilet, and getting in and out of bed. IADLs, developed subsequently by Lawton (Lawton & Brody, 1969), measured people's ability to perform complex tasks—housework, taking medications as prescribed, managing money, shopping for groceries or clothing, etc. Noting inconsistencies in disability trends revealed by these ADLs and IADLs measures, the National Research Council (2009) called for examinations estimating prevalence and trends in disability. In addition, they questioned whether traditional concepts of ADLs and IADLs continued to be adequate survey-based measures (National Research Council, 2009).

Recent shifts in the conceptual assessment of functional measures include outcomes addressing vision function as well as measures that arise from the ICF. Consistent application of these approaches is an evolving endeavor (Bruyere, Loovy, & Peterson, 2005). Bruyere et al. (2005) reviewed the recent literature related to the ICF's endorsement of these changes in assessing functioning, disability, and health outcomes and concluded that the ICF provides a framework that promotes the role of personal and environmental factors in many areas of health and functioning. Bruyere et al. found that the ICF classification was applicable when examining chronic conditions and sensory impairments. When using the ICF framework to address sensory impairments, Bruyere et al. concluded that the ICF needs further development. For example, Imrie (2004) argues that the ICF is limited in its theoretical underpinnings and falls short in specifying the nature of impairment and disability among some populations. Therefore, future research is needed to clarify some conceptual components to increase the ICF's capacity and influence. Other researchers have specifically utilized an ICF framework to address needed support for including vision impairment and comorbid conditions in the public health arena (Crews & Campbell, 2001).

Crews and Campbell (2001) used the ICF to analyze data from the National Health Interview Survey (NHIS) 1994 Second Supplement on Aging to examine health conditions, activity limitations, and participation restrictions among people aged 70 years and older with visual impairments. These researchers found that a hierarchical pattern existed as impairments predicted consistent disparities in activities and social participation. These findings were used to encourage public health approaches for this population and to highlight the need for specific applications of these concepts among people with vision impairment and selected comorbid conditions.

Given the previously outlined demographic changes in the aging population and approaches to assessing the characteristics and outcomes of older adults, researchers have recently examined the effects of comorbid conditions among older people. Goodman, Posner, Huang, Parekh, and Koh (2013) created a metric for defining, identifying, and using information about chronic conditions in the United States. After conducting a rigorous review of multiple data sources, Goodman et al. identified 20 chronic conditions to serve as a standard list for use when framing a public health agenda. Ten conditions are particularly common among older people and include hypertension, congestive heart failure, coronary artery disease, stroke, arthritis, asthma, cancer, chronic obstructive pulmonary disease, depression, and diabetes. Neither vision impairment nor hearing loss is included among the 20 selected conditions.

While vision and eye health, including vision impairment, are increasingly framed as public health concerns, it is in the presence of vision impairment with chronic conditions that health and social consequences are magnified (Crews et al., 2006). There are few complications more feared among older adults than the risk of experiencing activity limitations (e.g., driving, reading, keeping accounts) or participation restrictions (e.g., going to church, working, having meaningful social relationships). These limitations are often associated with vision impairment and the effects of other chronic conditions (Rubenstein, 2006). Rubenstein (2006) observed that unstable balance, for example, was a serious concern among older adults. In addition, these complications led to substantial rates of mortality and morbidity, and contributors to immobility among this population. Moreover, Rubenstein (2006) concluded that because no single cause for these limitations could be identified future studies should utilize multi-dimensional approaches to identify risk factors along the life course. These risk factors include movement and mobility limitations, and other complications resulting from vision impairment and/or comorbid conditions.

Within the scope of framing health problems, especially for older people, increased attention is being directed toward managing multiple chronic conditions. This strategic framework has been characterized as an escalating public health concern (Parekh, Goodman, Gordon, & Koh, 2011). Parkeh, Goodman, Gordon, and Koh concluded that risk factors for chronic conditions must be clarified as these conditions can overwhelm families and health systems. Therefore, Parkeh, Goodman, Gordon, and Koh argued, increased identification and management of risk factors should be priorities for future research, especially in national initiatives.

Healthy People 2020 (HHS, 2010), sponsored by the U.S. Department of Health and Human Services, identifies the most significant threats to health and establishes national goals to reduce those threats (Healthy People 2020, 2010). The vision objectives of HP 2020 assert a national goal to improve the vision and eye health of the nation through prevention, early detection, treatment, and rehabilitation. Specific vision objectives were first included in Healthy People 2010, which contained 467 specific objectives grouped into 28 focus areas. These objectives reflected extensive collaboration with public health experts, and included more than 350 national organizations and 270 state agencies.

Healthy People 2020 objectives are grounded in scientific evidence and cover a wide spectrum of health behaviors, environmental factors, and determinants of individual and community health. In addition, the objectives operationalize two overriding goals: (a) to enhance life expectancy and the quality of life, and (b) to eliminate health disparities between various segments of society including gender, race/ethnicity, education, income, disability, rural residents, and sexual orientation. The objectives of HP 2020 move beyond the original objectives focusing on improved vision and hearing health of the Nation through prevention, early treatment, and rehabilitation. These objectives were developed to encourage research designed to understand vision impairment and its associated impact on independence, especially as people age. Ultimately, the Healthy

People Consortium (Healthy People 2020, 2010), which developed the vision and hearing objectives, plans for scientific findings to be translated into interventions to help people who are blind and visually impaired maintain their quality of life and independence. Deficits in previous research, increased attention to vision in the public health arena, and expanded national objectives included in HP2020 support the research conducted in this study.

This study investigated the combined effect of vision impairment (including specific eye conditions) and comorbid health conditions on activity measures, as operationalized by the ICF framework (World Health Organization, 2002). This investigation focused on older people (age ≥55 years), hereafter referred to as "older people," to characterize the consequences of vision impairment and comorbid conditions on mobility and visual activity limitations and participation restrictions.

Statement of the Problem

Vision impairment has long been viewed as one of the most feared disabling conditions (The Lighthouse Inc, 1995). In addition, vision impairment has been identified as a major cause of activity limitation and disability among older people (Desai, Pratt, Lentzner, & Robinson, 2001). When vision impairment co-exists with comorbid conditions, these activity limitations are often magnified (Crews et al., 2009). Moreover, many disparities exist in the causes of vision impairment among some racial/ethnic groups (Sommer et al., 1991). Consequently, vision impairment and its complications are increasingly conceptualized as public health concerns (CDC, 2012). These complications and subsequent personal and societal costs are outlined in many publications and agendas of public health organizations and research programs (CDC, 2012). Many of these objectives are outlined in the national health concerns and objectives included in Healthy People 2020. However, few comprehensive models exist examining the synergistic nature of vision impairment and comorbid conditions. Therefore, expanded research is required to document the magnitude of complications among older adults with vision impairment and comorbid conditions at the population level.

As briefly addressed above and detailed in chapter II, six factors capture the significance of the current study and illustrate the significance of the problem addressed in the current research. These six factors include: (a) the dynamic, dimensional nature of disability requires focused research to clarify limitations among older adults; (b) differing definitional approaches of multiple chronic conditions and case definitions of vision impairment result in inconsistent frameworks of disability and social consequences; (c) people who experience vision impairment are generally not like people without vision impairment; (d) differential case definitions often lead to differential outcomes in functioning and participation; (e) numerous federal objectives have outlined future national health and functional goals; and (f) vision impairment and comorbid conditions are increasingly being framed within a public health approach.

This study addressed the absence of comprehensive theoretically based research to identify and document predictors and consequences of vision impairment co-existing with comorbid conditions among older adults.

Purpose of the Study

The purpose of this study was to investigate selected outcome variables among older adults with and without self-reported vision impairment or in conjunction with comorbid conditions to determine the effect of vision impairment and comorbid conditions on mobility and visual activity limitations, and participation restrictions. Previous research has shown the existence and consequences of vision impairment among older adults. However, few studies have examined nationally representative data to compare older people with vision impairment and comorbid conditions. This study addressed this gap in previous research by documenting the likelihood of experiencing selected mobility or vision activity limitations, or participation restrictions among the four specified groups of older adults.

Specifically, this study utilized data from the 2008 National Health Interview Survey (NCHS, 2009), which is the most recent nationally representative data that includes expanded vision, health condition, and activity limitation and participation restriction questions, to examine predictors of complications of self-reported vision impairment coupled with comorbid conditions among older people. In addition, selected demographic variables and geographic location were analyzed to determine their relationships to the prevalence of vision impairment among older people. This study used logistic regression techniques to compare four groups of older people. These comparisons included older people with no self-reported vision impairment or comorbid conditions, older people with vision impairment only, older people with comorbid conditions only, and older people with both vision impairment and comorbid conditions. This study documented statistically significant relationships among these four groups and reveals the likelihood, expressed as odds ratios, of experiencing mobility or vision activity limitations, or participation restrictions among older people. In addition, this study examined predicted probabilities among these groups and documented the linear relationship of older adults experiencing either of the selected mobility or vision activity limitations, or participation restriction as they age.

Research Questions

The project examined the most recently released population based survey data (NHIS, 2009) that includes specific vision conditions and acuity measures to examine risk factors of selected mobility and vision activity limitations, and participatory restrictions among older people with and without visual impairments and comorbid conditions. Because of the factors outlined in chapter II, the following five research questions and hypotheses guided the study.

1. What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations participation restrictions?

   Hypothesis: There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.

2. What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.

3. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

4. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid condition only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

5. How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment

only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55. Hypothesis: There is an observed linear relationship between age and experiencing a mobility or vision activity limitation, or participation restriction among older people with no vision impairment or selected comorbid conditions, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.

These research questions and their respective hypotheses were examined through a series of descriptive analyses and maximum likelihood methods utilizing logistic regression techniques. Logistic regression techniques have been extensively utilized when analyzing binary outcome variables (Powers & Xie, 2000). These were utilized to determine the significance of age and other independent variables as predictors of the likelihood of experiencing mobility and activity limitations, and participation restrictions as measured by selected dependent variables included in the project data.

Theoretical Framework

The theoretical framework for this study is grounded on the life-span theory of control (Heckman & Schultz, 1995), and the roles of primary and secondary control in older adults with vision impairment (Wahl, Becker, Burmedi, & Schilling, 2004). Heckman and Schultz (1995) examined the concept of control within the framework of a life-span theory. Heckman and Schultz theorized that humans desire to create behavior-event contingences over the life-course and abhor losses in their abilities to produce these contingencies. Heckman and Schultz further contend that, from a life-course development perspective, pivotal events are those that increase, decrease, or threaten existing levels of control. Specifically, Heckman and Schultz examined primary control, which relates to behaviors directed on the external environments and involves attempts to change the environments to fit the needs of the individuals, and secondary control, which assists individuals when coping with failure or life-challenges. Heckman and Schultz contend future research should identify biological constraints that may limit control behaviors. This study conceptualized the presence of vision impairment and/or comorbid as pivotal life events (biological constraints) that altered an older person's ability to control his/her environment. In addition, these pivotal events affect an older person's mobility and vision activities, thus, increasing the likelihood of experiencing participation restrictions. Therefore, identification of these losses could reveal predictable declines along the life-course, thus allowing individuals to engage in anticipatory as well as secondary control processes.

Wahl et al. (2004) expanded Heckman and Schultz's (1995) work to specifically examine the roles of primary and secondary control in adapting to age-related vision impairment. Wahl et al. theorized that severe vision impairment substantially undermines life plans and future expectations that are critical for late-life development and maintenance of activities of daily living and instrumental activities of daily living. These losses present major threats along the life-course, especially in the later stages of life. Thus, two theoretical frameworks were incorporated in the approaches of this research. First, the ICF (Imrie, 2004) allows the classification of variables in a manner that embraces the dimensional experience of disability, which relates to Heckman and Schultz's (1995) work. These are captured in the mobility, activity, and participation measures in these NHIS data. Second, Wahl et al.'s (2004) work addresses the dynamic effects of vision impairment and multiple chronic conditions as people age.

This research utilized both theoretical perspectives while expanding previous work to examine the effect of vision impairment coupled with comorbid conditions on selected mobility and visual activity limitations, and participatory restrictions, specifically the likelihood these limitations occur during the later stages of life. This research employed three broad categories of independent variables including selected demographic characteristics, vision impairment, and comorbid condition variables. Dependent variables included selected mobility and visual activity limitation, and participation restrictions coded as dichotomous variables. A visual representation of the causal model is illustrated in Figure 1.

Definition of Terms

This study included a wide array of variables, which are labeled and defined according to the codebook accompanying the original data. These variables and their variable names, descriptions, labels, and values are included in Table A1. The definitions of other terms, concepts, and vision conditions listed below clarify how they were used in this study.

Mobility limitations. Defined in this study as any one of the mobility variables included in the original data such as walking, stooping, bending, or kneeling. These concepts fall within the ICF concepts of activities measuring difficulty in movement.

Vision activity limitations. Defined in this study as measures that capture the difficulty in performing activities that require some degree of vision to complete without difficulty.

Participation restrictions. Defined in this study as measures that capture the difficulty in engaging with people and performing social roles.

Comorbid conditions. Defined as two or more health or disabling conditions co-existing together in one of the groups examined in the study (Valderas, Starfield, Sibbald, & Roland, 2009).

Synergistic effect. Defined in this study as the combined effect of having more than one disabling, chronic, or health condition. The existence of multiple conditions has been shown to have a multiplied effect on health and/or functional outcomes (Chen et al., (2014).

Older people. Defined in this study as adults, age > 55 years.

Age-Related Macular Degeneration (AMD). Defined as an eye disease most often occurring in people age 50 years or older. It is most commonly referred to as AMD and attacks the macula, which is the small, sensitive area located in the center of the retina, needed for sharp, central vision, and for seeing objects clearly (NEI, 2008).

Diabetic retinopathy. Defined as an eye disease that occurs when diabetes damages the tiny blood vessels inside the retina. There are often no warning signs or symptoms; however, blurred or blocked vision may be experienced with diabetic retinopathy (NEI, 2008).

Glaucoma. Defined as a group of eye diseases that often occur in older adults. This disease affects the optic nerve in the eye and can occur in one or both eyes (NEI, 2008).

Cataracts. Defined as an eye disease that involves a clouding of the lens inside the eye. This disease does not spread from one eye to the other; however, it can occur in one or both eyes. Over time, the cataract may grow larger and cloud more of the lens, thus, making it harder to see. Treatment may include surgery and may be the most effective treatment. This surgery involves removing the cloudy lens and replacing it with an artificial lens (NEI, 2008).

Conceptual Framework

The purpose of this study was to investigate selected outcome variables among older people with and without self-reported vision impairment and/or comorbid conditions. Figure 1 provides a visual representation of the theorized relationship between older adults with and without visual conditions and comorbid conditions, and the independent and dependent variables are detailed in Table A1. Broadly, this study included the following independent variables: age, gender, race/ethnicity, marital status, region of the country, comorbid conditions, vision impairment, health status, and multiple measures of mobility and vision activity limitations and participation restriction. Respondent's age, gender, race/ethnicity, marital status, household income, health and region of residence constituted demographic characteristics and control variables. Variables associated with mobility and vision activity limitations and participation restrictions constituted dependent variables. This conceptual framework enables analyses to identify constructs of mobility and vision activity limitations and participation restrictions and their effects along the life course as theorized by Heckman and Schultz (1995) and Wahl et al. (2004).

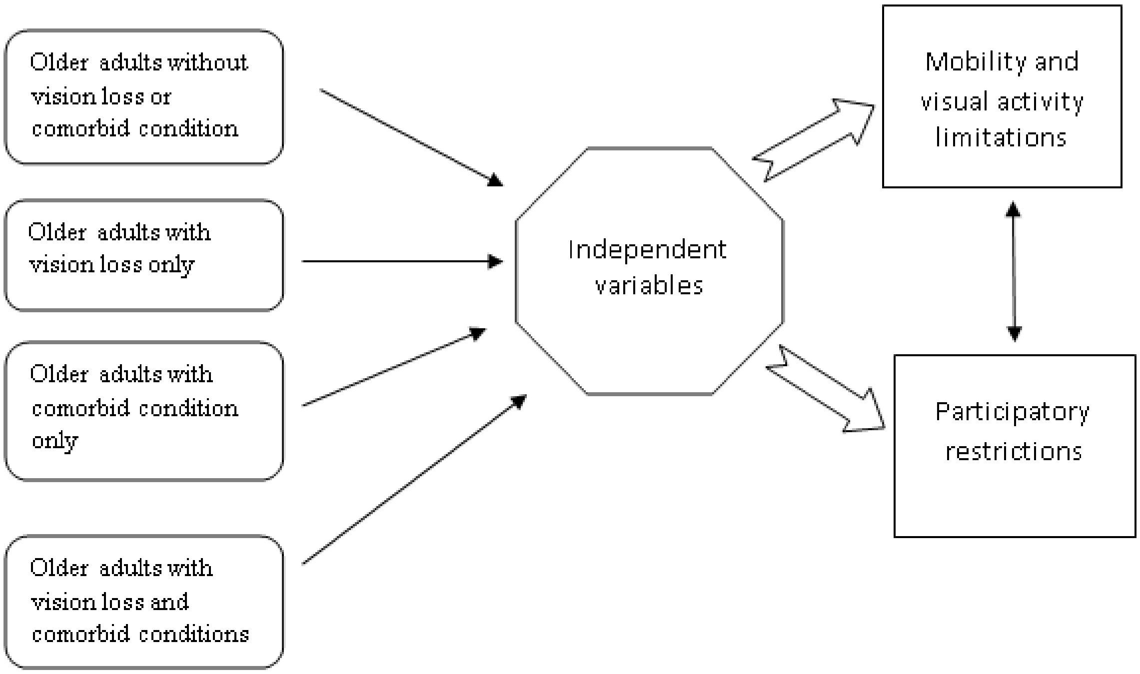

Figure 1. Conceptual framework.

Research Design and Methodology

Data analyses for this project were driven by secondary analysis of nationally representative survey data (NHIS, 2009). These data include the non-institutionalized, adult (age 18 years and above) sample of the 2008 National Health Interview Survey (NHIS, 2009). These data are the most recent nationally representative data that include detailed condition specific vision impairment, mobility, vision acuity, and participatory limitation variables. According to the NHIS website, the NHIS has monitored important national health behaviors and indicators since 1957. These data cover a broad range of health topics collected through personal household interviews among participants of all ages. Results from these interviews have provided data that are used to track health status, health care access, and progress toward achieving national health objectives (i.e., those included in Healthy People 2020). Analytic approaches utilizing these types of data have become commonplace in modern society with the development of new survey methods and analytic tools (Herrimga, West, & Berglund, 2010).

This study examined the effect of visual impairment alone and combined with comorbid conditions on older adults' likelihood of performing selected mobility and vision activity limitations, and participation restrictions. Research questions were divided into three types involving (a) description, (b) group differences, and (c) visual observations of these relationships. Questions involving description employed descriptive statistical techniques such as frequency distributions, percentages in categories, measures of central tendency (mean, median), and measures of variability (variance, standard errors, confident intervals; Thorne & Giesen, 2003). The types of analyses are explained in the appropriate section and subsections for each of the hypotheses investigated. In addition, methodologies related to analyses of complex survey data are included in the methodology section. All statistical tests employed a familywise alpha level of .05 and significant effects are reported odds ratios and probability values (Howell, 2002). Table A1 lists the variables and descriptors that were used for this study.

NHIS 2008 data were downloaded and read into Software Package for the Social Sciences (SPSS) v. 22 (IBM, 2013). Selected variables, including appropriate weighting and complex sampling variables were analyzed using SPSS v. 22 (IBM, 2013) with complex samples module. These data include comprehensive self-reported visual conditions, comorbid conditions, corrective lens usage, and variables associated with selected mobility and vision activity limitations, and participatory restrictions to examine and document risk factors among older adults with vision impairments and/or comorbid conditions. Research question 1 was analyzed using descriptive statistics and logistic regression procedures. A complex array of logistic regression procedures were employed to investigate research questions two, three, four, and five. Because this research focused on older adults self-reporting vision impairments and visual conditions, and is among few investigations utilizing nationally representative data, definitional, necessary analytic procedures, and public health concerns are detailed in the literature review.

Delimitations

This study was confined to investigating selected variables included in the 2008 NHIS. This research examined the impact of vision impairment and selected comorbid conditions among older people. Independent variables included available demographic characteristics and vision impairment measures, which include self-reported vision activity, and condition specific variables. Dependent variables include selected measures of mobility and vision activity limitations, and participatory restrictions available in the 2008 NHIS data. These condition and limitation variables can be conceptualized within the framework of the ICF. Analytic procedures included descriptive and categorical examinations among four specific groups of older adults, which are described as follows: (a) older people with no self-reported vision impairment or comorbid conditions, (b) older people with vision impairment only, (c) older people with comorbid conditions only, and (d) older people with both self-reported vision impairment and comorbid conditions. Because the data used in this study are obtained from a probability sample, the findings from these analyses are generalizable to the population of non-institutionalized older people in the U.S.

Significance of the Study

Given current trends toward a substantially larger aging population and concurrent increases in eye disease and vision impairment among older people, American public health and health care systems must improve their abilities to diagnose, treat, and provide rehabilitation services among older adults with vision and other comorbid conditions (CDC, 2006). Thus, research must utilize existing and future data to develop improved programs that address these concerns within this growing population (CDC, 2006). The disjointed nature of existing public policy and health programs has limited the dissemination and implementation of current research findings. The CDC, many state and national health agencies, and research agendas have long advocated for expanded diagnosis, treatment, and rehabilitation programs. Access to effective and affordable data and health programs is currently at a premium in the United States due to increasing budgetary concerns. Directed research examining the link between vision impairment, mobility and vision activity limitations, and participation limitations along the life-course among older adults is lacking. Thus, findings from this investigation are valuable to clarify the role of vision impairment and comorbid conditions in the later years of life.

This study contributes to the body of research as the relationship between vision impairment, comorbid conditions, and mobility and vision activity limitations, and participation restrictions among older adults addresses a gap in the existing literature by exploring the likelihood of experiencing mobility and vision activity limitations, and participatory restrictions among this population. In addition, this research addresses public health concerns outlined by governmental directives included in Healthy People 2020. This research examined whether there are significant differences in the likelihood of experiencing selected mobility and vision activity limitations, and participatory restrictions between older people who have no vision impairment or comorbid condition, vision impairment only, comorbid conditions only, and vision impairment coupled with comorbid conditions. This research seeks to increase the level of knowledge about the impact of vision impairment and comorbid conditions among older people. Administrators of rehabilitation programs, faculty, researchers, and policymakers can use findings from this study to address independent living training and rehabilitation programs to identify and reduce the likelihood of mobility, vision activity limitations, and participatory restrictions among this population.

CHAPTER II

REVIEW OF THE LITERATURE

While the introductory section of chapter I outlines the growing concerns for people with disabilities in general and vision impairment specifically in the U.S., especially among older adults, at least six factors and a theoretical approach should be considered in a systematic approach to the prevalence and effects of vision impairment combined with comorbid conditions. First, given the dynamic, dimensional nature of disability, a rigorous conceptual model is required to provide a common framework and common language to accommodate the complexity of vision and comorbid or multiple comorbid conditions. Second, agreed upon definitions of multiple chronic conditions and case definitions of vision impairment are important to create a consistent, rigorous approach to this topic and accurately populate a conceptual framework of disability. Third, people who experience vision impairment are generally not like people without vision impairment. People with vision impairment present magnified disparities defined by sex, race/ethnicity, income/education, as well as access and utilization. Fourth, differential case definitions and service approaches often lead to these differential outcomes in functioning and participation; therefore, a framework for understanding service dynamics must be considered. Fifth, numerous federal objectives have been outlined in HP2020 and must be incorporated into any investigation of vision impairment and chronic conditions. Sixth, vision impairment, chronic and comorbid conditions are increasingly being framed within a public health approach; therefore, an extensive overview of the framework of a public health paradigm must be considered. Finally, a theoretical framework must be considered as these factors are conceptualized within the context of predictors and interventions to alleviate the human and social costs of disability, vision impairment, and comorbid conditions. This study examines five research questions and hypotheses that collectively investigate whether older people with vision impairment and comorbid conditions are more likely to experience mobility and vision activity limitations, and participation restrictions than older people with vision impairment only, comorbid conditions only, or older people with neither vision impairment nor comorbid conditions. These disparities create a context for understanding different outcomes among people with vision impairment. The following literature review addresses each of these factors and provides a framework for the research questions examined in the project.

Models of Disability and ADL/IADLs

Disability is often operationalized as simply an inability to do something (Thomas, 2002). However, measuring disability represents a complex concept driven by meanings and applications from many disciplines and interests (National Research Council, 2009). For example, policy, scientific, medical, rehabilitative, and interests draw from different traditions and perspectives that reflect the purpose of those activities (Altman, 2009). Altman (2009) argued that definitional, measurement, and meaning inconsistencies continue because these various disciplines work within their own literatures, terminologies, and models of disability. Nevertheless, there have long been efforts to narrow these definitional differences. Nagi (1991) recognized these disciplines and set a stage to begin narrowing these conceptual differences. More recently, Altman (2009) acknowledged that generalization and acceptance of definitional components across disciplines maintain unique differences in these components. These similarities and differences are evident even in the efforts of the ICF (World Health Organization, 2002). This section outlines relevant perspectives of the ICF and its application to this current research.

An original model of disability, including elements of pathology, impairment, functional limitation, and disability, was conceptualized by Nagi (1964). However, this model was never presented in a symbolic or visual format; therefore, others have adapted the narrated concept into a visual model (Altman, 2009). Figure 2 includes Nagi's (1964) original model as presented by others and Altman's (2009) adaption of Nagi's model. Altman's (2009) model drives the conceptual model for the current research and is outlined below.

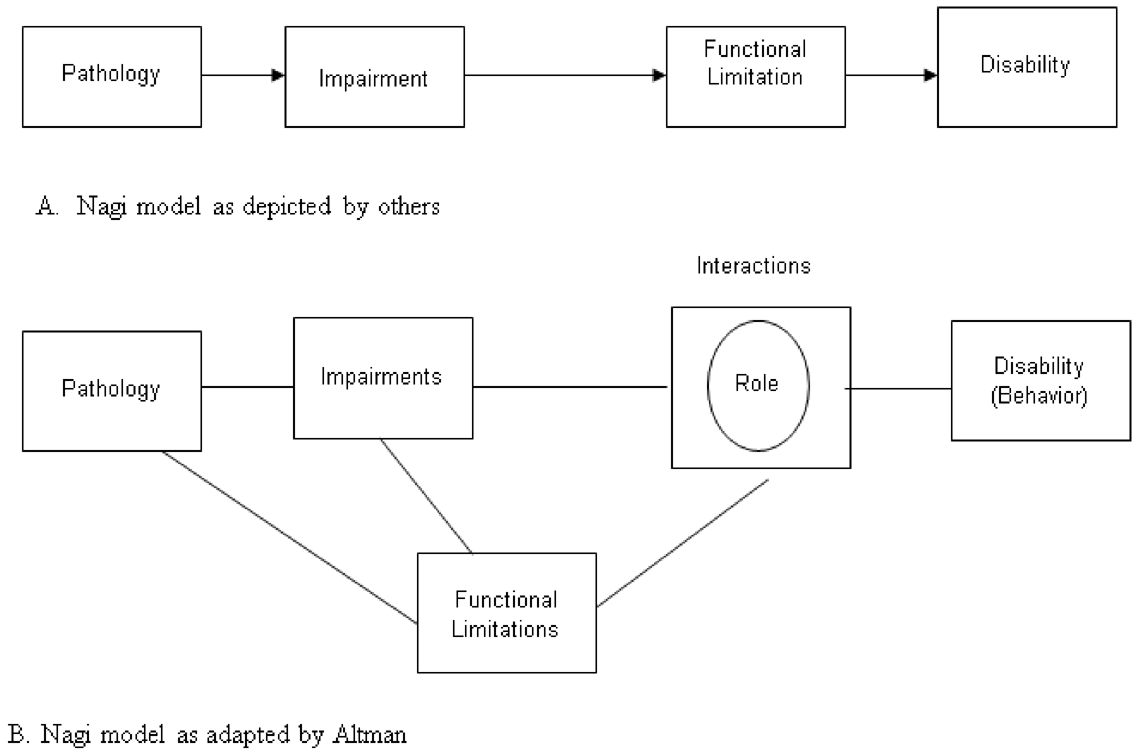

Figure 2. Nagi's original and Altman's revision of the original model (National Research Council, 2009).

Nagi's (1964) original model argued that disability is not the equivalent of an individual's conditions or impairments. Conditions and/or impairments are attributes of an individual that eventually affect the nature and degree of disability through his/her functioning. Disability refers to social outcomes or socially defined roles, which may include self-care, social participation, or employment. These roles are shaped by societal influences, personal expectations, and people around the "disabled" individual. In addition, people are impacted by their physical environments; thus, disability may reveal itself in the behaviors demonstrated by someone in social situations (Nagi, 1964).

Nagi (1964) later altered this perspective of disability to include a greater focus on orientation toward social functioning. Two strengths of Nagi's (1964) model remain.

The first strength is the recognition of differences between impairments, damaged body systems, and functioning. This recognition forces attention toward measurement of people's capacity rather than documenting specific conditions. The second strength includes the recognition of the important role social interaction with friends, family, and the community contributes to defining and measuring disability (Altman, 2009). Two other commonly referenced models of disability include one presented in *Disability in America* (Pope & Tarlov, 1991) and another by the Institute of Medicine (IOM) model from *Enabling America* (Brandt & Pope, 1997). Both of these are based on Nagi's original and revised models. More recently, the ICF (World Health Organization, 2002), which is a revision of the *International Classification of Impairments, Disabilities, and Handicaps* (World Health Organization, 1980), has received international support because it provides a taxonomy for classifying function, disability, and health with consistent concepts and terminology.

The ICF model (World Health Organization, 2002), allows us to understand the effects of disease at the organ (impairment), person (activity, activity limitation), and social levels (participation, participation restriction). The model provided standardization of language and concepts that serve as points of operationalization for measurement purposes. It is particularly useful as a planning and policy tool for decision-makers and researchers (World Health Organization, 2002). In the ICF model (World Health Organization, 2002), health or disease is presented as an intervening variable, and the pathology, condition, and impairment are measured at the person level (Altman, 2009). The ICF (World Health Organization, 2002) includes domains that help describe changes in body function and structure, and what someone can and cannot do in his or her usual environment. These domains are classified by means of two lists: the first is a list of body functions, and the second is a list of activities and participation. The ICF (World Health Organization, 2002) specifically stresses health and functioning, rather than disability. ICF (World Health Organization, 2002) represents a substantial shift away from a paradigm with disability beginning where health ends. The ICF (World Health Organization, 2002) is a tool for measuring functioning and participation in society, regardless of impairment. Figure 3 provides a visual representation of this model and shows how these approaches are ideal for this current research.

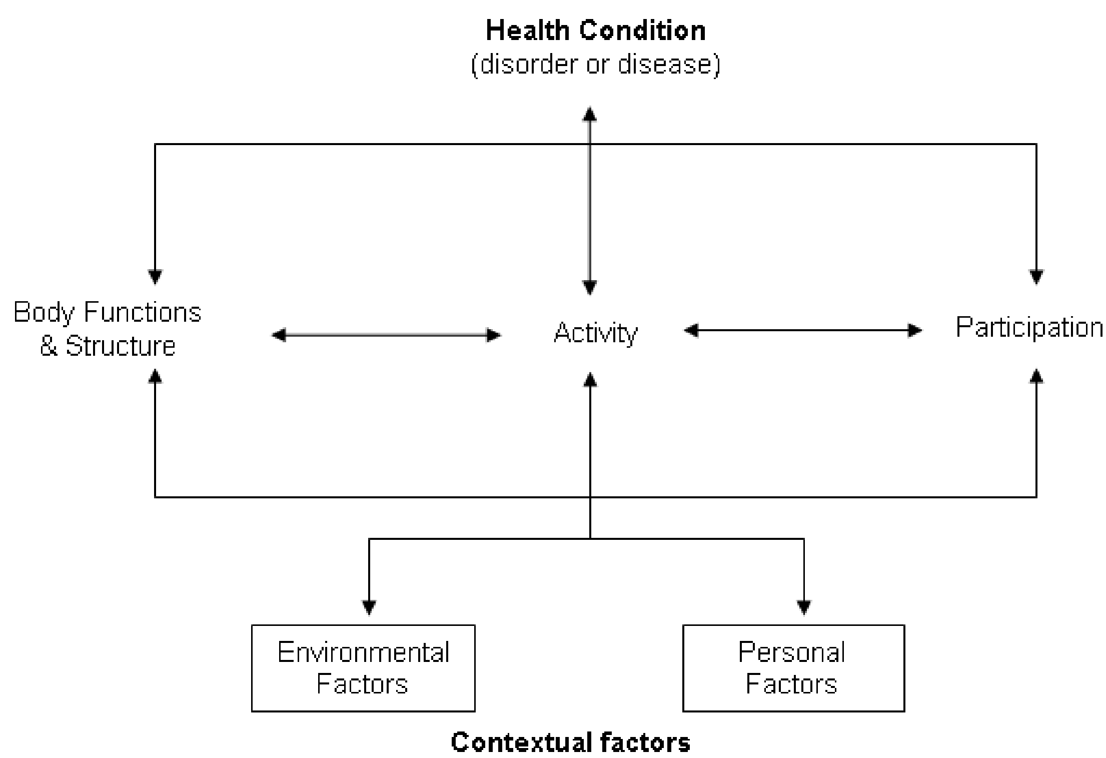

Figure 3. International classification of function framework (World Health Organization, 2002).

As evidenced by Figure 3, the ICF (World Health Organization, 2002) model includes domains that assess some of the dynamics between body functions and structure, and activity limitations and participation restrictions. Recent efforts to improve and standardize models of disability have also included advances in models to improve the measurement of physical, cognitive, and participation changes and/or limitations among people with disabilities, especially in late-life disabilities (National Research Council, 2009). The National Research Council (2009) prepared a summary report of an extensive workshop organized to examine recent advances in the improvement and measurement of disability in population based surveys, especially those of the elderly population. This is especially prevalent among this population because of the prevalence of chronic and comorbid conditions as well as increases in functional limitations. Advances in measurement techniques are described below and are followed by descriptions of chronic and comorbid conditions among this population.

Historically, ADLs and IADLs have been the most commonly used measures for estimating trends in disability from population-based surveys. ADLs typically measure people's abilities to perform certain tasks of daily living – without assistance – including eating, dressing, bathing, using the toilet, and getting in and out of bed. IADLs typically measure people's abilities to function independently in carrying out activities such as housework, preparing meals, shopping, managing money, and using the phone. These measures have been frequently utilized because they are easy to incorporate into and administer in surveys. However, recent observed inconsistences in findings based on ADLs and IADLs raise the question of whether traditionally constructed ADLs and

IADLs continue to be sufficient as survey-based measures of disability (National Research Council, 2009).

As previously indicated, the ICF (World Health Organization, 2002) defines disability as a broad dimensional concept that captures the differing components of disability, referred to as impairments, limitations in activity, and restrictions in someone's ability to participate in social roles. Altman (2009) noted that when we operationalize these concepts into narrow theoretical constructs, decisions must be made as measures are selected to represent the components. Thus, there are at least four levels of measurement that may be reflected in the shift toward an ICF (World Health Organization, 2002) operationalization of ADLs and IADLs, which includes basic action, specific tasks, organized activity, and role participation. Altman (2009) argued that each of these represent an increasing level of action or activity. As discussed in chapter III, the 2008 NHIS includes questions that represent these levels of activities and participation.

According to the National Research Council (2009), there is little consensus in the literature about how to classify activities, but several domains emerge across literatures related to aging, time use, and participation. These include the following domains:

- Basic self-care activities (includes ADLs and other activities that people do to care for themselves, such as management of chronic conditions),
- Household maintenance activities (e.g. IADLS and other household-related activities that are essential for daily life),
- Regenerative activities (e.g. hobbies, arts, music, gardening, puzzles, taking classes),

- Physical activities (e.g. exercise, walking for pleasure, participating in team sports),
- Social participation (e.g. socializing with friends and family, attending group functions),
- Productive participation (e.g. work, volunteering, providing childcare and adult care), and
- Political or civic participation (e.g. involvement in home associations or board meetings, political participation involving collective decision-making; National Research Council, 2009, p. 44-45)

Participants of the National Research Council's (2009) workshop concluded that there were six subject areas where future disability research should focus. The present study focused on two of these six areas – classification of disability (vision impairment and comorbid conditions), and measures of mobility and vision activity limitations, and participation restrictions within environments of older people with late-life disabilities. Specifically, Wallace (2009) argued that disabling illnesses were not being characterized very well and late-life disabilities must be distinguished from other disabilities. Wallace (2009) notes that others argued that loss of function and comorbid conditions in late life are particularly important if one wants to assess the effectiveness of interventions for older people at the societal level. It is within the context of population-based surveys where these dynamics can be measured and generalized to the national population. However, the complex nature of comorbid conditions must be considered among older adults.

Comorbid Conditions

Disabling conditions among older adults have been a well-known phenomenon for decades (Jette & Laurence, 1981). Jette and Laurence (1981) reported a 41% prevalence rate of chronic disease and/or comorbid condition among older adults and concluded that the high prevalence of chronic conditions in older adults, coupled with the anticipated growth in the older population will force public policies to address specific disabling conditions and the health complications that often occur in later life. In addition, Jette and Laurence argue that simple knowledge transfer is not enough. Addressing specific questions about the nature and extent of disabilities and/or chronic conditions among this population, Jette and Laurence's (1981) research examined four aspects of disability among older adults including physical, emotional, mental, and social components of life. They concluded that additional research must be conducted to characterize the impact of comorbid conditions upon older people. More recently, researchers have reported similar results, which served as a foundational justification for this study (Anderson & Horvath, 2004).

Mirroring increases in America's older population is an increase in the numbers of older adults reporting chronic conditions (Anderson & Horvath, 2004). Anderson and Horvath (20040 noted there were 125 million Americans (45% of the population) reporting a chronic condition and 61 million (21%) reported multiple conditions. Anderson and Horvath note that these numbers are expected to grow over the next 30 years. Moreover, these high numbers result in a substantial proportion of health expenditures being allocated to people with chronic conditions. Specifically, Anderson and Horvath found that 78% of health care dollars are spent on behalf of people with chronic conditions, and the majority of these expenditures are spent on people with multiple conditions. Along with higher costs exists higher rates of chronic conditions, which are substantially higher among older adults. In addition, Anderson and Horvath. found that services were particularly uncoordinated among health care providers, including home health, physicians, and clinics. Therefore, Anderson and Horvath argued for coordinated care among health care providers and future research directed to clarifying the dynamics of chronic conditions. These efforts would enable clearer communication among these providers, thus allowing coordinated care to become the standard of care for people with chronic conditions. Anderson and Horvath's (2004) work opened other avenues of research among these populations allowing other researchers to examine new aspects of chronic conditions.

Parekh et al. (2011) examined multiple chronic conditions within a strategic framework for improving health outcomes and quality of life. Parekh, Goodman, Gordon and Koh report their findings are consistent with previous work, which indicated disproportionally higher rates and costs of chronic and multiple chronic conditions among older adults. Similarly, Parekh et al.'s findings indicated an outmoded and uncoordinated system of care existed. Moreover, this system was only designed to address acute care and manage single chronic conditions, and was unable to address the dynamic nature of multiple conditions. In response to these circumstances, Parekh et al. (2011) promoted a framework that provided specific, actionable, and national-level strategies that advocated four interdependent goals: (a) foster health-care and public health system changes to improve the health of individuals with multiple chronic conditions (MCCs), (b) maximize the use of proven self-care management and other services by individuals with multiple chronic conditions, (c) provide better tools and information to health-care, public health, and social services workers who deliver care to individuals with MCCs, and (d) facilitate research to fill knowledge gaps about, and interventions and systems to benefit, individuals with MCCs. The third and fourth goals are specifically related to future research and include a call for research targeting subgroups that experience unique limitations from MCCs. Other researchers advocate for a more standardized approach to defining and measuring chronic conditions (Goodman et al., 2013).

Given population projections of continued growth in numbers of older people with and without chronic and MCCs, Goodman et al. (2013) argued for a clear model to conceptualize understandings and measures of chronic conditions in the United States. Goodman et al. offer two primary limitations with previous models. First, there have been inconsistencies in specific definitions and diagnostic classification schemes of chronic conditions. Second, there have been differences in data collections systems and the measures included in these systems. Goodman et al.'s work targeted these limitations and identified 20 conditions that should be included in data collection systems to focus on chronic and comorbid conditions. Other researchers have examined many of these conditions as they co-exist with vision impairment (Crews et al., 2009).

Crews et al. (2009) conducted a retrospective study using multiple years of NHIS data to examine the effects of specific chronic conditions among people with vision impairment. Crews et al. examined the effect of diabetes, hypertension and heart disease, depression risk, stroke, hearing impairment, joint and low back pain, and breathing problems when occurring with vision impairment. Crews et al. found that in all cases, people with vision impairment and these selected comorbid conditions experienced the greatest limitations in physical functioning and participation, and worsening health in the past twelve months. However, these findings did not explore predictors or the effect size of the observed limitations. These findings highlight the objective of this current research. As stated earlier, whether occurring with or without any comorbid conditions, people with vision impairment face substantial challenges thus justifying unique approaches to maximize physical functioning and social participation. Therefore, the effects, dynamics, extent, and future directions of research among older adults with vision impairment and comorbid conditions are outlined in the following section.

Effects of Visual Impairment

The dynamics surrounding vision impairment are extensive, ever increasing, and continually evolving (Hinds et al., 2003). Substantial vision loss often leads to denial, anger, depression, loneliness, and anxiety, especially among older people dealing with other compounded losses related to aging (CDC, 2006, 2012; Flax, Golembiewski & McCalley, 1993; Negrin, 1983; Rogers & Orr, 2000). In addition, the American public's attitudes about the acquisition of vision impairment have long been shaped by fear and misinformation (The Lighthouse International, 1995). The Lighthouse report (1995) noted that fears associated with acquired vision impairment were second only to mental or emotional illness. In their study, the Lighthouse (1995) found that 53% (43 million) of middle-aged and older Americans have had personal experiences with vision impairment or know someone with a visual impairment. More recently, the NEI (2008) reported that 71% of Americans rated vision impairment as having the greatest impact on their daily life. However, only small percentages reported knowledge about the early signs of specific eye conditions, recognition of the term “low vision,” or hearing about eye disease in the past year. The National Eye Institute (2008) contended these findings reinforce the critical need to educate the public about common eye diseases.

Vision impairment without being accompanied by comorbid or chronic conditions is a major cause of activity limitation and disability among older people (Desai, Pratt, Lentzner, & Robinson, 2001). Desai et al. noted that approximately 1.8 million non-institutionalized older adults report some difficulty with basic activities such as bathing, dressing, and walking around the house, in part because they are visually impaired. Vision impairment increases the risk of falls and fractures, making it more likely that an older person will be admitted to a hospital or nursing home, be disabled, or die prematurely (Chan, Pang, Ee, Ding, & Choo, 1997; Desai et al., 2001; Ivers, Cumming, Mitchell, & Attebo, 1998; Onel, Zeid, & Kamarthi, 2010). Collectively, prior research may be inconsistent, but clearly illustrated the need for identification of risk factors and intervention strategies that can help older persons develop effective compensatory functioning and maintain or regain independence. Improved services and surveillance can reduce federal, state, and individual costs by actively dealing with the cause of the problem (vision impairment) and not simply reacting to the symptom (loss of independence; Zambelli-Weiner & Friedman, 2012). Expanded knowledge about these dynamics and improved strategies to increase access to vision services may reduce the economic burden on society and help fulfill obligations to older adults by helping them maintain their independence through vision rehabilitation and/or services (The Lighthouse International, 1995). Moreover, these services may include extensive independent living and/or basic eye care services. This survey revealed substantial inequities among women and people with low incomes when seeking basic eye care services, including screening services and corrective lenses. Moreover, The Lighthouse found that these screening and corrective lenses services were among the top ten priorities among older adults.

Prescription lenses are almost universally needed among older persons (Desai et al., 2001). Specifically, 92% of persons 70 years of age and older wear glasses or corrective lens, and 18% also use a magnifying glass for reading and close work (Desai et al., 2001). In addition, people with macular degeneration, the leading cause of blindness among the elderly, may need up to 10 times as much light to see as younger persons with normal vision. These findings were similar to those from earlier data collected from the Lighthouse National Survey on Vision Impairment (The Lighthouse, Inc., 1995). That survey revealed that clinical low vision services, rehabilitation training in activities of daily living, and recreational services for persons with vision problems were each used by only 1% of persons age 45 and older with a self-reported vision impairment. In this early research, when asked why vision services were not used, a sizeable proportion of respondents reported being unfamiliar with their availability. Sixteen percent of people surveyed reported being unaware of training in daily skills being available through any rehabilitation services. The most notable finding may be that 35% of middle aged and older adults did not know if there were local public or private agencies in their communities that provided vision rehabilitation services.

Similar findings are consistent in more recent research (Owsley et al., 2008). These findings are especially disconcerting since approximately 85% of people with visual impairments have useful residual vision and could benefit from vision services and/or rehabilitation (Bruce, McKennell, & Walker, 1991; Leat, Fryer, & Rumney, 1994). These findings highlight the increasing need to conduct new investigations and disseminate information about vision impairment and its effects, especially along the life course, thus contributing to the framing of vision impairment and its effects in the public health arena. However, inconsistent case definitions of vision impairment in national surveys and previous research have presented numerous challenges in vision related research designed to document functional limitations among older people (Crews et al., 2013).

Definition and Prevalence of Visual Impairment

While there is no standard case definition for vision impairment in national or other surveys (Crews et al., 2013), visual acuity is often categorized into three levels of functioning: normal vision, low vision, and blindness (Corn & Koenig, 1996; Fletcher & Colenbrander, 1999). Approximately 10% of people with vision impairment are totally blind (Hollins, 1989). The remainder of people reporting vision impairment retain some usable vision. Thus, the concept of visual impairment is complex and a consistent definition does not exist; therefore, a conceptual framework of vision impairment is necessary when framing research.

Many times vision impairment and low vision are used interchangeably. Low vision or visual impairment often describes people who are neither totally blind nor fully sighted and may be defined as “a vision impairment that is severe enough to interfere with the ability to perform everyday tasks or activities, and that cannot be corrected to normal by conventional eyeglasses or contact lenses” (Jose, 1992, p. 209). Low vision can be any condition in which a person’s vision is not adequately meeting his or her needs (Kern & Miller, 1997). Silverstone, Lang, Rosenthal, and Faye (2000) define low vision or partially sighted (visual impairment) as a significant reduction of visual function that cannot be corrected to the normal range by ordinary glasses, contact lenses, medical treatment and/or surgery. These terminology and conceptual issues are complicated by self-report measures often used in surveys to determine visual impairment. Vision impairment can be determined as either unaided (i.e., no corrective devices) or with corrective devices (e.g., glasses, contact lenses, binoculars). Measuring vision impairment with corrective devices may be described as presenting vision and is often used to best reflect a person's everyday vision (Tate et al., 2005). The idea of presenting vision is reflected in the wording of self-report questions included in the NHIS (2009) data.

The definitional inconsistency of vision impairment introduces the difficulty in describing a clear definitional paradigm operationalizing visual impairment. This difficulty contributes to present challenges in framing the public health policies, and rehabilitation or low vision services, which are necessary to address limitations often associated with vision impairment. These public health concerns are addressed in a specific subsection of this literature review. Rehabilitation service is a term service providers use to refer to intervention, assessment of functional vision, dispensing of optical and non-optical aids to enhance and augment visual functioning, counseling and training in the use of low vision aids and devices and follow-up services (Goodrich & Luek, 2004). These services and/or rehabilitation programs, which present their own set of definitional inconsistencies, are ideally designed to improve functioning or reduce the risks associated with vision impairment. While it was not the primary focus of this current study, the scope of services was examined by the estimated totals of people using rehabilitation services and devices.

As discussed in Chapter Three, the 2008 NHIS (2009) includes a wide array of self-reported vision impairment and vision condition variables. The NHIS (2009) has historically revealed relatively large estimates of vision impairment. Early NHIS surveys revealed that more than 3 million older Americans were severely visually impaired (Williams, 2000). Other surveys, conducted within similar time periods, reported that there were 6.6 million older visually impaired (severe and non-severe) persons (Crews, 2000a). Included in these numbers are groups with unique networks potentially available to them for services, such as the Department of Veterans Affairs. In 1995, it was estimated that there were 93,000 legally blind veterans (Goodrich, 1995). By 2010, the number of legally blind veterans was projected rise to over 147,000 and 880,000 with severe visual impairments (Goodrich, 1995). Veterans are often considered to have reasonable access to quality health care, low vision services, and related vision rehabilitation services. However, some racial/ethnic and other groups (inside and outside of these unique networks) may not be fortunate, which must be a focus for future research. Nevertheless, it is accepted that the prevalence of vision impairment increases with age (CDC, 2006)

It is well documented that the numbers of older people are increasing and the characteristics of this population are rapidly changing (Ortman, Velkoff, & Hogan, 2014). In terms of numeric scope, Ortman et al. (2014) reports that this population is expected to reach 86.4 million by 2050 and comprise 21% of the total population. This increase equals a 147% increase between 2000 and 2050. Advanced age groups will also experience substantial growth. For example, the numbers of centenarians (seniors age 100 years or older) are projected to increase from approximately 67,500 to more than 580,000 by 2040. This aging of the baby boomer generation presents some unique public health challenges (Talley, 2007). Talley (2007) notes that many seniors in the 55 to 65 age range may be caring for family members who are 90 years and over. These older seniors may be healthier than their younger caregivers. Therefore, seniors in the 75 to 85 age range may be the most vulnerable from a chronic or comorbid condition perspective. The reported prevalence of vision impairment and potential vulnerability includes substantial disparities among varying racial/ethnic groups.

Disparities of Vision Impairment

Estimates from the U.S. Census (2010) note that people born between 1946 and 1964 (baby boomers) began turning 55 in 2001; therefore, the number of older people will continue to increase dramatically through 2030. Early in the 21st Century, these Baby Boomers began entering the minimum age to receive specific services from many federal and/or state programs designed to address concerns about vision impairment among this population. When translating this rise into national totals, the results are remarkable. The 2010 U.S. Census indicated that there were more than 76.6 million people age 55 and over, or about 24.8% of the 308.7 million Americans. Many related factors, such as increasing disability rates and health conditions, accompany these population estimates, which are especially relevant to this current study. Recent reports from the U.S. Census (2010) indicated that there were almost 20 million adults between age 55 and 64 years. In addition, there were more people age 65 years and above in 2010 than ever before, and this population is growing faster than any segment in the U.S. population (Werner, 2011).

These data also indicated notable population characteristics within the age 55 years and above population. For example, adults age 65-74 total 21.7 million, which comprised almost 54% of the population age 65 and above. In addition, older adults age 85–94 are the fastest growing group age 65 years and above. Other demographic characteristics are notable for this proposed research. These characteristics include regional population totals, which highlight needed research. The Southern Region of the U.S. revealed the largest numbers of older adults, age 65 years and above. The Northeastern Region revealed the smallest number of adults, age 65 years and above, but the largest numbers of people were 85 years and above. Finally, the Western Region revealed the fastest growing region for those 65 years and above. As discussed in Chapter Four, regional analyses were conducted to examine potential variations in prevalence rates of vision impairment when controlling for the independent variables in the study. Moreover, given these existing and the following projected demographic characteristics, research is needed as vision impairment and comorbid conditions are increasingly framed as public health concerns (CDC, 2012).

Consistent with other findings, Sansing (2006) projected that people age 65 years and above will grow to more than 72 million between 2010 and 2030. Other projections indicate population changes for people between age 55 and 85 years will stabilize around 2030; however, the proportion of the oldest-old (those over 85) will grow rapidly after 2030, when the baby boomers again enter a new age group. This projected population increase indicates that the population age 85 and over could grow from 4.2 million in 2000 to nearly 21 million by 2050. This projected population growth magnifies the need for targeted low vision services, diagnostic procedures, and interventions that were highlighted decades ago by Stults (1984). Stults (1984) argued that expanded services and research were necessary to address the needs of aging populations. Thus, Stults (1984) contended that these long-range projections are particularly relevant when referring to prevalence estimates because, regardless of the variations in population characteristics and required attention to and demand for effective intervention, diagnostic and individual vision services will increase.

Other seminal research highlights demographic concerns in older populations, especially as prevalence rates of vision impairment are concerned Massof (2002). Massof (2002) examined results from several nationally representative surveys and compared five population-based prevalence studies that screened for visual impairments to determine the prevalence (existing numbers) and incidence rate (new numbers) of low vision and blindness among adults in the U.S. Massof (2002) considered the often-overlooked effect of mortality on the *net* annual increase of prevalence rates of visual impairment, particularly low vision. When accounting for the high rates of mortality among older populations, Massof (2002) concluded that, although the net annual growth in demand for vision related services may be slower than often stated, two factors are apparent: (a) there is a back-log of people seeking vision services; and (b) the annual need for low-vision products and services exceeds the annual growth in low-vision prevalence by a factor of 10. One of the keys to minimizing this inequality is accurate identification of consequences of vision impairment. Similar to previously reported data, Ryskulova et al. (2008) examined 2002 NHIS vision data and found that only about 2% of people with vision impairment accessed vision rehabilitation services. Access to rehabilitation services is one of the HP 2020 objectives, which are outlined in a subsequent section of this chapter.

Vision impairment is often disproportionately prevalent among some racial and ethnic minority groups (Gohdes, Balamurugan, Larsen, & Maylahn, 2005). Gohdes et al. (2005) reported that among community-dwelling (e.g. non-institutionalized) adults the prevalence of low vision and blindness increases dramatically with age in all racial and ethnic groups. In addition, caucasians have higher rates of macular degeneration than African Americans, but glaucoma is more common among older African Americans. Between 2000 and 2020, the prevalence of blindness is expected to double (Gohdes et al., 2005). These statistics are consistent with earlier findings. For example, the Baltimore Eye Survey (1985-88) found bilateral blindness far higher among African Americans than Caucasians (Sommer et al., 1991). In addition, Rahmani et al. (1996) found that the causes of bilateral blindness differed by race, with Caucasians more likely to have age-related macular degeneration and African Americans more likely to have primary open-angle glaucoma. Rahmani et al. also found higher incidences of diabetes and diabetic retinopathy among both African American and Hispanic populations. Additionally, less severe visual impairments were higher among African Americans than Caucasians (Rahmani et al., 1996). More recent data indicate many of these findings continue. Zhang et al. (2012) reported that African Americans, age 40 and above, experience disproportionately higher rates of diabetic retinopathy, glaucoma, and cataract surgeries. Moreover, Hispanic Americans experience disproportionately higher rates of macular degeneration, glaucoma, and cataract surgeries.

When prevalence rates of people with vision impairment are examined in light of projected demographic changes in the nation's older population, it is clear that the need for vision services will continue to increase, especially among underrepresented groups. However, the growing service needs are not simply due to increasing numbers; economic costs continue to rise. The National Alliance for Eye and Vision Research (2006) estimated that vision impairment and disease cost the United States $68 billion annually in direct healthcare costs, lost productivity, and diminished quality of life. However, according to Prevent Blindness America the total annual cost of vision impairment has risen to $139 billion. Moreover, current and projected population totals reveal that these trends will continue their rapid increases. These costs and associated dynamics are complicated by the omissions of specific eye care and vision impairment in the recently implemented Affordable Care Act (Gustin, 2013). Therefore, many federal objectives have been developed to frame vision impairment as a public health concern.

Healthy People Initiatives

As mentioned previously, several initiatives have been suggested to narrow the foci toward the prevalence, effect, social and economic cost of vision impairment, comorbid conditions, and activity limitations and participatory restrictions. However, one federal initiative first began to clearly direct the nation's focus to the complexities of vision impairment, and its associated conditions, effects, and costs. Expanding on the first set of national targets for health released in 1979 (Meadows-Oliver & Allen, 2012), in 2000 the United States Department of Health and Human Services released *Healthy People 2010*, which outlined the nation's health goals for the following decade (Davis, 2000). For the first time, *Healthy People 2010* included a chapter on vision and hearing, which highlighted required attention to the effects of sensory loss. These objectives, grounded in scientific evidence, covered a wide spectrum of health behaviors, environmental factors, and other determinants of individual and community health. In addition, the objectives operationalize two overriding goals: to enhance life expectancy and the quality of life; and to eliminate health disparities between various segments of society including gender, race/ethnicity, education, income, disability, rural residents, and sexual orientation. Moreover, these objectives encouraged research designed to understand vision impairment and its associated impact on independence, especially as people age.

Based on findings from HP 2010, *Healthy People 2020* divided sensory losses into separate topic areas including vision, hearing, and other sensory or communication disorders, which includes disorders of the ear, nose, throat, and conditions associated with voice, speech, and language. Objectives from HP 2010 (U.S. Department of Health and Human Services [HHS], 2010) that failed to move toward their goals were carried over into the new directives and two new areas were added. These new objectives include specific efforts to address visual impairment due to age-related macular degeneration, general direction to include all age-related vision impairment, and the proportion of Federally Qualified Health Centers (FQHCs) that provide comprehensive vision health services. The goal of this work is to continue building on the success of *Healthy People 2010* and continue efforts promoting vision and eye health as a health priority. These objectives illustrate the growing attention vision impairment and its associated complications are receiving in documenting research findings that can be used to disseminate knowledge, and develop programs, services, and procedures that can lessen the impact of these complications. Therefore, previous research about the prevalence, costs, complications, and national perspectives of vision impairment among older adults must be considered.

These vision objectives coupled with the other objectives in *Healthy People 2020* demonstrated the gap in necessary resources directed toward many of the comorbid conditions that cause difficulties in performing activities of daily living among people with vision impairment. Specifically, the decline in activities of daily living and participation are some of the most debilitating complications for people aging with vision impairment. Moreover, this risk is magnified when vision impairment is coupled with comorbid conditions.

The two overriding goals in the HP 2010 objectives (Davis, 2000) are carried over into the HP2020 objectives including extending life expectancy and improving quality of life, and eliminating health disparities between different population groups, including those related to gender, race/ethnicity, education, income, disability, rural environments, and sexual orientation. Developers of these objectives contended that of the five senses, people depend on vision and hearing to provide critical cues for accomplishing the-basic activities of daily living. Throughout all stages of life, vision and hearing allow people to easily navigate and remain orientated in their environments. Alone or together these senses may decline or become absent from heredity, aging, injury, or disease. The development of improved disease prevention, detection, access and utilization, treatment methods, or more effective rehabilitation strategies must remain a priority (HHS, 2010). Because these losses may occur along the life course or instantly from trauma, a public health perspective must emerge to guide identification and reduction of vision impairment and its consequences. Thus, the prevention of initial or additional sensory and/or comorbid impairments requires substantial resources and continuing investigation.

Public Health and Surveillance

Even though the United States promotes many important public health goals, two are especially important. One fosters environments, programs, and services that allow healthy individuals to live in healthy communities. Another encourages people working with programs or providing health related services to help people pursue quality of life rather than simply live in absence of diseases (Talley & Crews, 2007). Even with these important goals of public health, promoting them among people with disabilities has been neglected in the general public health community (Rimmer, 1999). Rimmer (1999) contends that recent attitudinal and funding priority changes among researchers, funding agencies, and health care providers and consumers have led an effort to establish higher-quality health care for millions of Americans with disabilities. In addition, these efforts have largely been driven by consistent growth in the numbers of people with disabilities, changes in public policies, and improving attitudes toward people with disabilities.

Data from the 2010 U.S. Census estimate a population of approximately 56.7 million Americans with a disabling condition that substantially limited their independence and/or activities of daily living (Brault, 2012). The growing realization that large numbers of Americans experienced some type of disabling condition led Congress to pass the Americans with Disabilities Act in 1990, which provided landmark legislation that empowered people with disabilities (Emens, 2012). This legislation included policies that required reasonable accommodations in the workplace and treatment options for previously overlooked disabilities. Therefore, the importance and influence of the ADA is an ongoing reality as people with disabilities gain greater equality and maximize opportunities for employment and independence (Emens, 2012). Moreover, the numbers of people with disabilities continue to increase. The realization that there are large numbers of people with disabilities has drawn attention to numerous other federal initiatives.

The Administration for Community Living (ACL), within the U.S. Department of Health and Human Services, was created in April 2012 by merging the Administration on Aging, Administration on Intellectual and Developmental Disabilities, Center for Disability Policy, and Center for Management and Budget and acts as the focal point for programs, policies, and initiatives designed to remove barriers that prevent people with disabilities from full participation in society. As described in the following section and discussed elsewhere in the literature review of this study, eliminating health disparities was a key goal of Healthy People 2020. There were 467 Healthy People objectives in this initiative and 207 of them specifically affect people with disabilities. This initiative highlighted the increased need for specific programs that affect the health of people with disabilities. However, many disabling conditions or groups of individuals have struggled to gain acceptable recognition within some segments of the rehabilitation and/or public health community and other avenues in broader society (HHS, 2010). Two such areas involve overall independent living needs of people in the later years of life and caretakers.

As *Healthy People 2020* and the previously documented literature indicate, vision impairment often results in significant suffering, disability, loss of productivity, and lower quality of life for millions of Americans. Consequently, vision impairment and comorbid conditions have been documented as major public health concerns that cause a substantial human and economic burden on individuals and society (CDC, 2010). Because vision impairment has been shown to affect multiple areas of people's lives (CDC, 2006), these losses are magnified in older adults and can result in social isolation, increasing risk of declining activities of daily living and participation, and specifically depression (Cappella-McDonnall, 2005; CDC, 2006). As numbers of people with various sensory losses increase, researchers, administrators, and service providers have been encouraged to develop new strategies to prevent these numeric increases from being translated into increased morbidity and its associated personal and societal costs. Therefore, the CDC (2010) and other agencies have called for a comprehensive approach to the public health concerns of vision impairment, especially as these concerns are magnified in older adults.

To address this growing concern, the CDC (2010), through the Vision Health Initiative (VHI), and diverse stakeholders, began developing a coordinated national public health framework to prevent vision impairment and blindness and its impact on society. In addition, the National Commission of Prevention Priorities identified vision screening among adults 65 years of age and older as one of the top ten priority areas for effective clinical preventative services that can be offered in medical settings (Maciosek et al., 2006). The CDC and Prevention have promoted a Public Health Surveillance system to further new knowledge and improved quality of life for people with vision impairment. Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of outcome-specific data for use in public health action to reduce morbidity and mortality and to improve health outcomes (Lee et al., 2012).

Surveillance systems often detect outbreaks of infectious diseases; however, chronic disease surveillance differs in that the outcomes are multifactorial and of varying latency. Chronic disease surveillance applies to tracking and forecasting for all aspects of chronic disease. These include risk factors and social determinants of health, events, access to and utilization of health care, and other related outcomes (e.g., functional, disability-related; CDC, 2010). In addition, these chronic disease systems rely on multiple data sources, analytic techniques, and expanded investigations to integrate and disseminate findings. To formalize its commitment to addressing the public health concerns of vision impairment and begin developing a relevant surveillance system, the CDC (2010) formed a Vision Health Initiative. This team's goals are to integrate surveillance and epidemiological assessment, application of public health research, and action for programs and policies as illustrated in Figure 4.

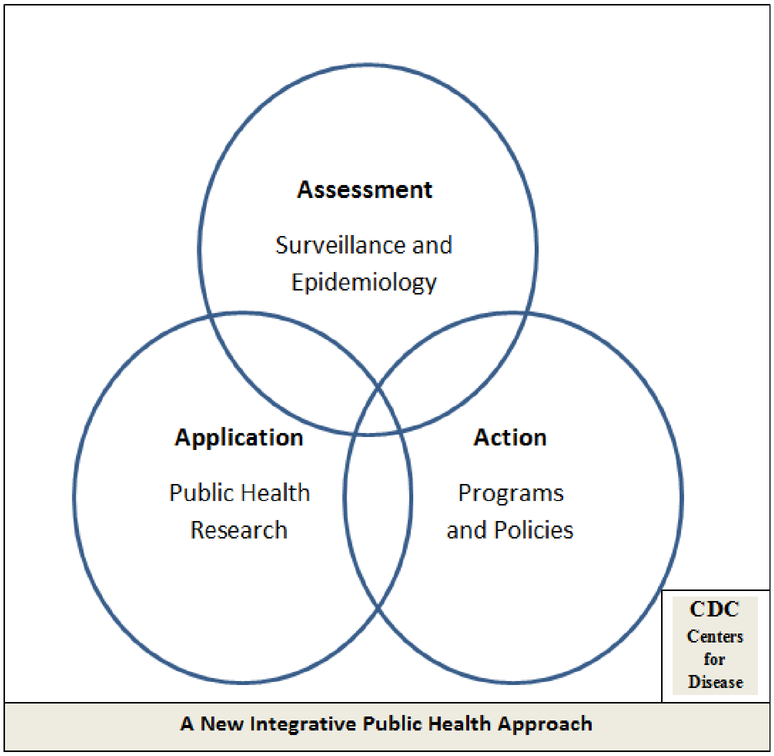

Figure 4. A new integrative public health approach (CDC, 2010).

Development of these collaborative efforts has revealed several deficiencies of vision and eye research when translating scientific findings into widespread and effective community health efforts and improved clinical care models to reduce and improve the nation's vision health. Therefore, several comprehensive and coordinated vision health strategies and action steps were identified and promoted to help address these shortcomings. These activities are directed to assure the nation's vision health through assessment, application, and action. These three action steps are described in the following sections.

Assessment: Surveillance and Epidemiology

In a recent supplemental issue of the *American Journal of Ophthalmology*, West and Lee (2012) presented a foundational argument for establishing a national vision surveillance system. West and Lee argued that surveillance serves as the foundational element of public health programs. The CDC (2006) reported as early as 1986 that the final link in a surveillance system is to apply data toward prevention and control of health conditions. These systems facilitate effective monitoring, prioritizing, and evaluating diseases and health conditions. West and Lee (2010) contend that the principles historically applied to surveillance systems utilized for infectious diseases could transfer to chronic diseases. Moreover, West and Lee argue disparities in rates of vision impairment justify directing resources in national surveys for surveillance purposes to detect and reduce the documented disparities in vision impairment. These disparities highlight inequalities in health outcomes and inequitable use of health resources. Finally, West and Lee concluded that obtaining accurate data is a first step in developing a surveillance system.

Assembling multiple data systems and/or data sets is a critical element of effective assessment of the prevalence, effects, and costs of vision impairment. These data sources should include measurements of visual acuity and cause-specific diseases. In addition, these data sources must include information about national vision and eye health data from a nationally representative sample, and include data from minority groups and high-risk populations (CDC, 2006). Five strategies have been identified by the CDC (2006) to address the assessment initiative to improve the Nation's vision health: (a) assess the role of available data sources in measuring and monitoring vision and eye diseases, (b) improve current vision impairment and eye disease data collection, (c) explore innovative mechanisms to collect data, including data sources, (d) maximize the impact of collected and analyzed data, and (e) assess the impact of blindness and vision impairment throughout the lifespan. Implementing these strategies can play substantial roles in establishing a comprehensive and effective surveillance system.

Application: Applied Public Health Research

The second component of the surveillance includes application–applied public health research, which addresses the need to develop, test, and implement evidence-based interventions in clinical and community practices. In addition, this component encompasses a public health approach that utilizes public health research to address the economic costs of vision impairment and develop cost-effective models for eye diseases among various population groups (CDC, 2006). The goal of public health in the United States is to promote healthy people living in healthy communities. People should be able to pursue quality of life rather than focus on avoiding disease (Talley, 2007).

The Institute of Medicine promotes three functions of public health–assessment, policy, and assurance, and maintains that quality research is an integral component of each of these functions (Berkowitz, 1998). Moreover, applied public health research contributes to the CDC’s (2010) efforts to develop a framework for a comprehensive, integrated initiative dedicated toward vision health. This initiative will effectively enhance other efforts to address the public health coverage of vision impairment. It will decrease duplication of efforts, enhance collaboration, and increase the ability to meet measurable objectives. This objective can serve as a catalyst to bring vision health into the public health arena and help guide the public health community in its efforts to improve the nation's vision health. However, the initiative requires strong science and evidence-based perspectives to identify selection of strategies and actions for the initiative. These strategies include efforts to (a) evaluate the social and economic burden of vision and eye diseases, (b) evaluate the cost-effectiveness of interventions to improve vision and eye health, (c) increase the understanding of access and utilization of vision care services, and (d) evaluate the application of behavior change models to utilization of care and health care provider practices.

A public health research approach is necessary to address the economic costs of vision disorders and develop cost-effective models for eye diseases among diverse populations. This public health research approach will facilitate estimating the true economic burdens of vision disease and loss, which is essential for informing policy makers and for obtaining needed resources to develop and implement effective interventions. In addition, this approach, which must include collaborative research, will inform future planning efforts through effective data analysis and systematic reviews of interventions to promote screening for vision impairment, and a review of access and utilization of vision care in the United States (CDC, 2006). When implemented, these public health strategies will enhance awareness, promote education, and increase access to successful prevention, treatment, and rehabilitation services among populations at the greatest risk for vision impairment and potential limitations (CDC, 2010).

Action: Program and Policy Development

According to the CDC (2010), the third action step directed toward combating the nation's vision health deficits includes action directed toward public health programs. These programs must be designed to prevent diseases and conditions by promoting healthy lifestyles, and changing health systems to encourage appropriate provider and patient behaviors. In addition, these actions must identify strategies to modify environmental determinants of the consequences of vision impairment. Moreover, these actions should results in programs, policies, and systems changes that focus their priorities among all life stages. These changes should increase awareness of vision health and vision disorders, prevent unnecessary vision impairment, and increase access to adequate vision care (CDC, 2006). These actions include efforts to: (a) develop public health intervention programs, (b) enhance the role of existing public health programs within federal agencies, state, and local health agencies, and community-based organizations, (c) encourage modifications to existing health care systems to better meet the vision health needs of all Americans, and (d) recommend health care policies to improve vision health.

These strategies and identified actions are comprehensive in their scope. In whole, or in part, their implementation can reduce or eliminate many of the identified gaps in this literature review.

Integrated model. The CDC (2010) contends that addressing the consequences of visual impairment and its frequent resulting disability can best be accomplished through organized, population-based systems incorporating factors that shape the disability experience. These systems must include broader and more inclusive investigations that integrate specific outcomes and health indicators that are critical components of a comprehensive public health approach. The ultimate goal of vision health surveillance, including attention to eye disease, visual impairment, and related disability, is the development of practical interventions for prevention, treatment, and rehabilitation at all stages of life, and the improvement of eye health and quality of life. This system is critical to understanding the vision and eye health of populations and can serve as a foundational effort for improved vision health promotion and prevention programs at the local, state, national, and international levels. These goals are clearly visualized in Figure 5.

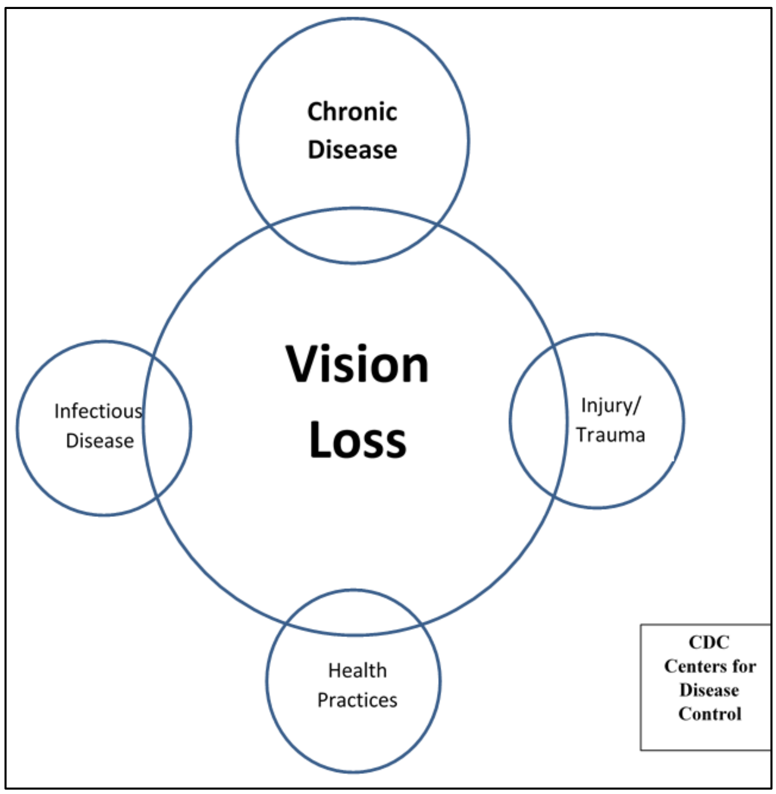

Figure 5. Factors impacting vision loss
(CDC, 2010).

As discussed earlier, there are specific goals for any public health surveillance system including estimating the consequences of diseases and monitoring longitudinal changes over time and within various populations. This study's literature review reveals gaps in understanding many of the dynamics of eye disease, visual impairment, and comorbid conditions, especially among certain populations. The CDC (2010) Vision Health Initiative contends that integrated research findings are necessary to facilitate data-driven decision making around resource allocation and rehabilitation programs at the national and local levels. Moreover, for public health problems like vision impairment, which often includes complex, multi-factorial etiologies and underlying disparities in risk and associated health outcomes, widespread generalized interventions are often ineffective and impractical. Therefore, primary goals of vision health surveillance are to identify and characterize disparities, particularly with regard to vision–related disability, comorbid conditions, and associated conditions.

Clarifying the factors that may contribute to the persistence of vision health disparities and outcomes will be informative for developing targeted interventions in vision health. In addition, the Vision Health Imitative (2010) population-based studies in the United States and globally have demonstrated that a significant proportion of older adults with visual impairment have treatable or preventable disorders. One important goal of a national vision health surveillance system is to evaluate and advance achievement of Healthy People Objectives (see Figure 6). The CDC (2010) reported that data sources such as the NHIS can help elucidate recent trends in eye care utilization (including receipt of comprehensive eye exams with dilation), visual impairment due to age-related macular degeneration, glaucoma, diabetic retinopathy, and cataracts, and use of vision rehabilitation services and adaptive devices among those with visual impairment. In addition, timely analysis and interpretation of these self-reported data can provide a useful tool for tracking progress towards achieving three of the four Healthy People Objectives (listed previously; CDC, 2010). Moreover, the National Health and

Nutritional Examination Survey (NHANES) data can address the prevalence of uncorrected refractive error among US adults (CDC, 2010). Therefore, analysis and interpretation of these data will directly measure progress towards achieving the *Healthy People 2020* objectives, and should be priority for researchers in the field of visual impairment.

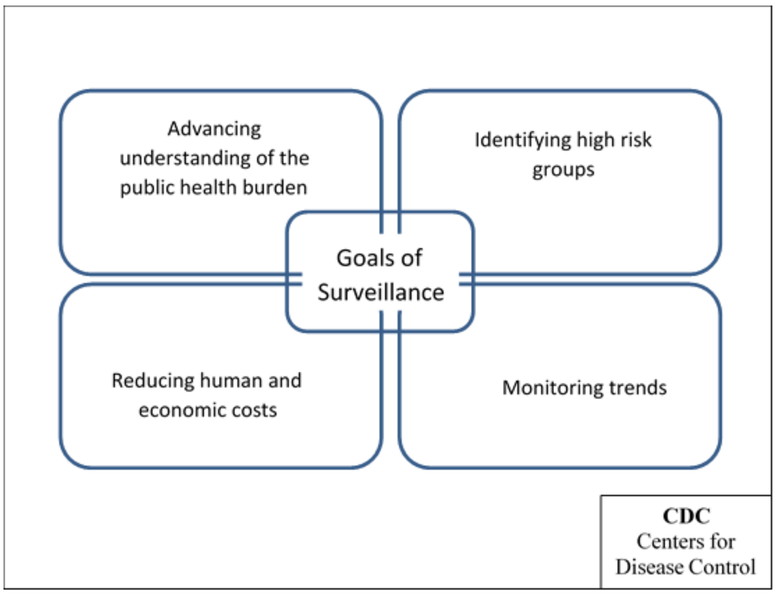

Figure 6. Goals of surveillance

(CDC, 2010).

Assessments and Prevention

As reported earlier, a review of current U.S. Census projections indicate a dramatic increase in the number of U.S. citizens age 55 and above (US Census Bureau, 2010). In addition, economic and other literatures reveal tremendous risks of disabling and other health conditions among this population. Some of the risks include falling and fear of falling. Moreover, economic literature reveals costs associated with the risks, health complications, and disability among this population. Therefore, public policy has recently begun to examine a paradigm shift that includes movement from disability prevention to prevention and management of secondary conditions (Rimmer, 1999). Rimmer (1999) contends that terms such as wellness and health promotion are often not associated with people with disabilities. Therefore, Rimmer (1999) concludes that the absence of information on health promotion for people with disabilities has kept this subgroup out of the limelight and in the background of research agendas and programs across the United States. This exclusion has resulted in inadequate service delivery systems and increased susceptibility to secondary health conditions. With the expected increases in aging populations and people with disabilities, many new programs and sources of data are emerging. However, Rimmer (1999) concludes that there is an increased need to examine these new data to understand the relationships between risk factors of specific health and disabling conditions and secondary conditions.

Theoretical Framework

The preceding literature documents the prevalence, and personal and societal costs of vision impairment. In addition, the literature documents the importance of vision impairment and its human costs as substantial public health concerns. However, as evidenced by the absence of theoretically driven objectives, these findings are often driven by atheoretical considerations. This research builds on the documented findings by other researchers, public policy organizations, and health directives by analyzing secondary data within the theoretical framework grounded on the life-span theory of control (Heckman & Schultz, 1995) and the difficulty maintaining primary and secondary control in older adults with vision impairment (Wahl, Becker, Burmedi, & Schilling, 2004).

Heckman and Schultz (1995) examined the concept of control within the framework of life-span theory. These theoretical concepts follow earlier work directed toward understanding human behavior over the life course. Balets (1987) argued that research on life-span development over the previous two decades yielded foundational theories about changes in human behavior over the life course. However, Birren and Bengtson (1988) contended that these early ideas of aging along the life course included more focus on data than theory. To address these inadequate theoretical foundations, Heckman and Schultz (1995) theorized that humans desire to create behavior-event contingences over the life-course and abhor losses in their ability to produce these contingencies. Heckman and Schultz further contend that, from a life-course development perspective, pivotal events are those that increase, decrease, or threaten existing levels of control. Vision impairment can be considered a pivotal event that substantially limits people's ability to maintain primary and secondary control, especially in the later years of the life course (Wahl et al., 2004).

Primary and secondary control is often viewed as a two-process construct (Rothbaum, Weisz, & Synder, 1982). Rothbaum et al. (1982) examined primary control, which includes behaviors directed on the external environment and involves attempts to change the environments to fit the needs of the individuals, and secondary control, which assists individuals when coping with failure or life-challenges. Secondary control is viewed as efforts to adjust to life within an individual's existing world. These activities and/or behaviors can be contrasted with pivotal events that cause individuals to surrender control, which may result in helplessness and other behaviors that demonstrate the inability to control people's environment. Rothbaum et al. (1995) contend future research should identify biological constraints that may limit control behaviors. Identification of these losses could reveal predictable life events that limit functioning, thus allowing individuals to engage in anticipatory as well as secondary control processes.

Wahl et al. (2004) expanded Heckman and Schultz's (1995) work to specifically examine the roles of primary and secondary control in adapting to age-related vision impairment. Wahl et al. (2004) theorized that severe vision impairment substantially undermines life plans and future expectations that are critical for late-life development and maintaining activities of daily living and instrumental activates of daily living. These losses present major threats along the life-course, especially in the later stages of life.

This study utilized both of these theoretical perspectives to demonstrate the synergistic effect of vision impairment coupled with comorbid conditions as an example of decreased control in later life. In addition, this study expands previous work by examining the effect of vision impairment as a primary contributor to selected mobility and vision activity limitations, and participatory restrictions, specifically the probability of declines during the later stages of life. This study employed three broad categories of independent variables. These categories include selected demographic characteristics, existence of vision impairment, and previous medical history variables. Dependent variables included selected limitation variables as defined in Chapter Four. Specifically four groups of older people were compared to determine the likelihood of experiencing mobility and vision activity limitations, or participation restrictions among these groups.

Summary

Chapter Two provided the review of the literature. The research questions, theoretical and conceptual framework, International Classification of Functioning, Disability and Health (World Health Organization, 2002), vision and health components of Healthy People 2020 (Healthy People, 2010), and necessity of a surveillance model of vision impairment guided the literature review. Detailed attention was given to a review of the paradigm shift in the conceptualization of ADLs and IADLs toward the framework provided within the International Classification of Functioning (World Health Organization, 2002). In addition, the literature review included recent reports of the growing understanding of the combined effects of vision impairment coupled with other health conditions. Finally, considerable review included recent efforts to frame vision impairment as a public health concern.

Six factors and a theoretical framework were considered in a systematic way to address the prevalence and effects of vision impairment without or with comorbid conditions. These factors included early models of disability within the context of defining disability, operationalizing and measuring activities of daily living and instrumental activities of daily living, concepts of multiple chronic conditions, definitional and measurement challenges of vision impairment, effects of vision impairment, and conceptual considerations necessary as vision impairment is increasingly framed as a public health concern. Synthesis of these factors within a theoretical approach drawing from the life-span theory of control and the difficulty maintaining primary and secondary control in older people with vision impairment provided a framework for this proposed research. Five specific research questions and hypotheses are described in the following methodological approach. The causal model, illustrated in the Chapter One is further explained in the following chapter.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

The purpose of this study was to examine the most recently released population based data that included specific vision conditions and acuity measures to document risk factors of selected mobility and vision activity limitations, and participatory restrictions among older people without and with visual impairments and comorbid conditions. Because of the factors outlined in Chapter Two, the following five research questions and hypotheses guided the study.

1. What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations participation restrictions?

   Hypothesis: There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.

2. What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.

3. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

4. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid condition only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

5. How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55. Hypothesis: There is an observed linear relationship between age and experiencing a mobility or vision activity limitation, or participation restriction among older people with no vision impairment or selected comorbid conditions, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.

As previously stated, this chapter describes the data, research methodology, and analytic tools that were employed in this study.

Data

Data analysis for this project was driven by secondary data analysis of the 2008 National Health Interview Survey (NCHS, 2009), which is a cross sectional nationally representative survey. Contemporary survey methods and analytic tools permit the examination of large-scale, nationally representative surveys to measure health indicators, personal behaviors, chronic health conditions, employment trends, and many other topics (Herringa, West, & Berglund, 2010). Data and methods consistent with these survey applications were integrated in this study.

While modern applications allow these surveys to make countless contributions to contemporary social research, they are not without limitations. Historically, these surveys have been used to capture specific characteristics of the target population. For example, survey designers and administrators may use survey findings to simply describe household incomes, age-related preferences on political issues, or gender differences in heart conditions. However, it is becoming commonplace to use complex survey data to examine causal relationships among variables of interest. In addition, other agencies and researchers have called for increased usage of these surveys and their applications to be included in surveillance or monitoring systems for many chronic conditions in contemporary society (Lee, Teutsch, & Thacker, 2010).

Rooted in early efforts to monitor morbidity patterns, all states began collecting, compiling, and publishing weekly reports in 1925 (Lee & Thacker, 2011). Lee and Thacker (2011) also reported that these early efforts became more centralized in the early 1960s as the CDC assumed a major role in public health surveillance to provide national epidemiological profiles for the most important diseases and conditions. Recently, the CDC (2010) stated that a surveillance system should: (a) document the scope of health problems, (b) assess geographic distributions, (c) form and test hypotheses, (d) stimulate research, program design, implementation, and evaluation, and (e) uncover any changes in health and related behaviors. In this publication, the CDC (2010) recommended these surveys include components related to vision health, eye disease, vision related disability, or utilization of vision-related treatment or rehabilitation services. In addition, these surveys must be ongoing and continuous, meaning that they are administered at least once every five years. Moreover, the survey must include people above age 40, which include populations who are at greater risk for visual impairment. They identified 14 potential surveys that met the previously reported criteria and the NHIS (2009) was one of the 14 surveys.

Data for this study were obtained from the 2008 NHIS (NCHS, 2009), which is a principal source of information on the health of the civilian noninstitutionalized population of the United States. According to the NCHS, the NHIS is one of the major data collection programs of the NCHS, which is part of the CDC. NHIS data are used widely throughout the Department of Health and Human Services (DHHS) to monitor trends in illness and disability and to track progress toward achieving national health objectives. One of the objectives of the NHIS is to monitor the health of the United States population through the collection and analysis of data on a broad range of health topics. A major strength of this survey lies in the ability to display included health characteristics by many demographic and socioeconomic characteristics. In addition, these surveys include large sample size and multiple years of data. Thus, cross-sectional profiles of specific health conditions and consequences may be monitored as revealed though the data collection and analyses (NCHS, 2009).

As described on the NCHS website, the NHIS is administered annually and covers the civilian noninstitutionalized population residing in the United States at the time of the interview. These surveys do not include patients in long-term care facilities, persons on active duty with the Armed Forces (though their dependents are included), persons incarcerated in the prison system, and U.S. nationals living in foreign countries. The surveys are a cross-sectional household interview surveys. Sampling and interviewing are continuous throughout each year. The sampling plan follows a multistage area probability design that permits the representative sampling of households and non-institutional group quarters (e.g., college dormitories). The first stage of the current sampling plan consists of a sample of 428 primary sampling units (PSU's) drawn from approximately 1,900 geographically defined PSUs that cover the 50 States and the District of Columbia. A PSU consists of a county, a small group of contiguous counties, or a metropolitan statistical area. Within a PSU, two types of second-stage units are used: area segments and permit segments. Area segments are defined geographically and contain an expected eight, twelve, or sixteen addresses. Permit segments cover housing units that were built after the 2000 census. The permit segments are defined using updated lists of building permits issued in the PSU since 2000 and contain an expected four addresses. These sampling units are utilized to compute accurate observed alpha levels and standard errors in statistical analyses. Finally, the current NHIS sample design continues the oversampling of Black, Hispanic, and Asian persons.

Data for this study are found in the 2008 NHIS (NCHS, 2009) sample adult file, which includes 21,781 people. The 2008 survey is the most recent HHS data including expanded vision related questions. This sample is weighted with probability weights to produce nationally representative estimates. According to the NCHS website, The NHIS was redesigned in 1998 and includes a core set of questions each year to examine health trends among the non-institutionalized U.S. population. Each year the survey includes other questions that focus on various specific or unique health or disabling conditions that may affect the lives of non-institutionalized Americans.

NHIS data provide national population-based data to monitor various aspects of national health trends, including health and disability topics. The 2008 survey includes 20 questions that are specifically related to vision impairment and include measures of activity and performance limitations, and eye conditions. In addition, these data include ten of the twenty chronic conditions Goodman et al. (2013) argued should be included in future research among this population. Finally, these data contain nine mobility, six vision activity, and three participation variables, which are the potential dependent variables in this research. A detailed listing of these variables is included in Table A1, which includes a detailed description of each variable combined with other NHIS questions about demographics and characteristics, health conditions, and activity limitations, and participation restrictions. These data comprise an especially rich data set to examine the hypotheses generated in this investigation. New statistical techniques and software packages allow these variables to be examined to uncover relationships among vision impairment and comorbid conditions, and mobility and vision activity limitations, and participation restrictions among older people.

Variables

This study included an extensive array of demographic, vision impairment, vision conditions, health conditions, mobility and vision activity limitations, and participatory restrictions included in the 2008 NHIS Sample Adult file (NCHS, 2009). This study used the appropriate weighting variables as explained in the data section. Demographic variables included include sex, Hispanic ethnicity, race, marital status, region of residence, and health status, which were recoded as dichotomous categorical variables in the study. Age was the only continuous variable used in the study.

Vision, Comorbid Conditions, and Activity Related Variables

The NHIS is conducted annually through detailed interviews in representative households (NCHS, 2009). These interviews are conducted for every member of the household. Questions may be answered in person or by a verified “proxy” representative of the household member. To measure vision impairment, the survey includes a question that asks respondents (or a proxy) whether the person or someone in the household has *difficulty seeing even when wearing glasses or contact lens.* If the respondent reports having difficultly seeing, they are asked if they are blind or unable to see at all. In addition, the 2008 survey includes the following questions to determine the condition that caused the vision impairment (NCHS, 2009). The respondents are asked to respond yes or no to the following questions: (a) "Have you ever been told you had diabetic retinopathy and if so, have you lost vision because of diabetic retinopathy?"; (b) "Have you ever been told you had cataracts, and, if so, have you lost vision because of cataracts, and have you ever had cataract surgery?"; (c) "Have you ever been told you had glaucoma, and, if so, have you lost vision because of glaucoma?"; and (d) "Have you ever been told you had macular degeneration, and, if so, have you lost vision because of macular degeneration?"

In vision impairment related questions, people were asked if they: (a) currently wear eyeglasses or contact lenses, (b) wear eyeglasses or contact lenses to read/write/cook/sew, (c) wear eyeglasses or contact lenses to drive/read signs/watch TV, and (d) use any adaptive devices such as magnifiers or talking materials. In addition, they were asked six questions to determine the degree of difficulty they experienced performing activities that depended on vision acuity or ability to see. For this study, these variables are treated as measures of visual activity for the purposes of measuring limitations due to declines in visual acuity. For these questions, people were asked how difficult it was, even when wearing glasses or contact lens to: (a) see up close, cook, or sew, (b) go down stairs in dim light, (c) drive during the day time, (d) notice objects while walking, (e) read newspapers, and (f) find something on a crowed shelf. These responses were rated on a five-point Likert-type scale, with 0 being no difficulty, (1) meaning only a little difficulty, (2) meaning somewhat difficult, (3) meaning very difficult, and (4) meaning cannot do at all because of vision or do not do at all. These variables were analyzed to reveal the degree of difficulty among older people. In addition, the item revealing the greatest difficulty was modeled as a dependent variable to capture some degree of difficulty performing these activities resulting from vision impairment and/or comorbid conditions. These questions are used as vision activity related limitation questions within the ICF framework (World Health Organization, 2002), which make these data particularly relevant to this project.

Because the NHIS (NCHS, 2009) is driven by self-report vision and vision related variables, these data do not include clinically diagnosed eye disease or health condition information. However, this is not a substantial limitation because this project specifically focused on the impact of vision impairment alone or when accompanied with comorbid conditions. As detailed previously, the comorbid conditions included in this research include ten of the twenty chronic conditions identified by Goodman et al. (2013). Goodman et al.'s (2013) conceptual model proposes standardized approaches to define, identify, and use information about chronic conditions in the U.S. Chronic conditions included in this proposed research include asthma, depression, diabetes, hypertension, arthritis, stroke, coronary disease, congestive heart failure, cancer, and emphysema. In addition, this research included variables that assess self-reported hearing loss because hearing loss is an integral impairment, especially when coupled with vision impairment (Agrawal, Platz, & Niparko, 2012). Hearing loss is determined by asking participants if they (or someone in the household) now or ever had used a hearing aid; and if they have ringing, roaring, or buzzing in their ears. In addition, people are asked to rate their hearing on a five-point Likert scale.

Other potential dependent variables in this project include two aspects of ADL activities that are fit within the ICF (World Health Organization, 2002) framework. The first includes measures from nine questions that access separate aspects of a respondent's activity limitations concerning mobility. The second includes three questions that assess a person's difficulty to participate in his/her social environment.

Because this study conducted a thorough investigation of the demographic characteristics of people age 55 years and above with no vision impairment or activity limitations, vision impairment only, comorbid conditions only, and vision impairment coupled with comorbid conditions and the relationship between condition specific, and mediating variables associated with mobility and vision activity limitations, and participation restrictions, analyses of these questions are guided by five research questions.

Data Collection and Measurement Techniques

Data collection consisted of physical acquisition of the publically available databases; appropriate installation of the data files into an SPSS Ver. 22 (IBM, 2013) data file; necessary "cleaning," labeling, and recoding the data; ensuring all coded variables have valid codes; ensuring that missing value declarations are appropriately used; and other programming to ready the data file for efficient and accurate analysis. It should be noted that data cleaning is an important process brings the data set to a state of analysis readiness. Measurement techniques were not an issue over which the project researcher had much control. However, close attention was given to the measurement level of each variable so that appropriate aggregation and analysis methods were employed in all research questions. Institutional Review Board (IRB) permission from Mississippi State University was requested for approval in order to conduct this study. A copy of the Mississippi State University IRB approval letter is included in Appendix B.

Data Analysis

This study examined the effect of visual impairment combined with comorbid conditions that limit a person's ability to function on the likelihood of experiencing mobility and vision activity limitations, or participatory restrictions. The hypotheses under investigation involved the relationship of visual impairment combined with other condition variables and demographic variables on the likelihood of experiencing these limitations along the life-course. The types of analyses used in the study are explained in this section and subsections for each analysis. In addition, methodology related to analysis of complex survey data is included in this section and further clarified in Chapter Four. Descriptive findings are reported as frequency distributions, percentages in categories, measures of central tendency (mean, median), and measures of variability (variance, standard errors, and confidence intervals). All statistical tests employ a familywise alpha level of .05 (Howell, 2002).

Five research questions and their respective hypotheses were examined in this study. These questions were examined by descriptive and maximum likelihood methods, which included logistic regression. Initial data analyses were conducted to examine these data for outliers, missing data, and to determine any appropriate re-coding strategies. This selection used all respondents in the survey for initial analyses; however, final analyses set older people, age 55 and above as the sub-population. In addition, appropriate weighting procedures were employed within the complex data analysis plan. Basic frequencies and logistic regression procedures were performed with SPSS version 22 with complex sample module (IBM, 2013). These methods are fully described for each research question as follows:

Research question one was as follows:

1. What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations participation restrictions?

   Hypothesis: There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.

Because the research objective in research question one was largely descriptive, analysis employed descriptive statistical techniques such as frequency distributions, percentages in categories, measures of central tendency (mean, median), and measures of variability (variance and standard errors). Prevalence data were calculated and analyzed to produce national estimates. Demographic categories (e.g., gender, race/ethnicity, etc.) were calculated and/or recoded appropriately. The responses to these questions produced nationally representative, detailed prevalence data including a description and distribution of this population, which included older people with no vision impairment, vision impairment only, comorbid conditions only, and older people reporting both vision impairment and comorbid conditions. This information provided a foundation to examine the other research questions in this study.

Research questions two through four are as follows:

2. What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.

3. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

4. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid condition

only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?

Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

Research questions two, three, and four utilized logistic regression techniques to determine the likelihood people with vision impairment and/or comorbid or health conditions experience mobility, vision acuity, and participatory limitations. A hierarchical approach to categorical regression techniques was employed to determine the incremental impact of predictors or groups of predictors. These procedures follow contemporary categorical statistical procedures (Long & Freese, 2006; Powers & Xie, 2009). Regression-based relationship analyses included incremental and absolute effect size measures for categorical analyses such as Wald χ^2, confidence intervals, statistics measuring the percent variance accounted for such as Cox & Snell, and t-tests. Finally, the likelihood and effect size measures are reported as Odds Ratios, which are commonly used to measure the association between the occurrences of two or more events (Viera, 2008).

Research question five was the following:

5. How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment

only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55. Hypothesis: There is an observed linear relationship between age and experiencing a mobility or vision activity limitation, or participation restriction among older people with no vision impairment or selected comorbid conditions, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.

Research question five was addressed with categorical regression techniques and the conversation of odds ratios into predicted probabilities. The primary statistical tools for these questions employed logistic regression with the addition of saving predicted probabilities. These probabilities are displayed visually to examine the trends as older people age. Because the logic-based methods are non-linear, this approach allows predicted probabilities to be visualized in a manner to examine the trends in changes along the age curve. This approach provides an interpretation of the strength of association; however, substantively meaningful interpretations should be based on predicted probabilities and functions of those probabilities (e.g., ratios, differences). These interpretations are easily computed with the latest version of SPSS (IBM, 2013) and are graphed by condition by age by condition group. The predicted probabilities are then compared across independent variables and outcomes to determine incremental effects of changes in age.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

The research investigated selected demographic control and limitation variables among older people with and without self-reported vision impairment only or in conjunction with comorbid conditions to determine the prevalence and effect of vision impairment and comorbid conditions on selected mobility and vision activity limitations, and participation restrictions. This study utilized data from the 2008 NHIS, the most recent nationally representative data that includes expanded vision, health condition, and activity questions, to examine predictors of complications of self-reported vision impairment among this population (NHIS, 2009). In addition, selected demographic variables and geographic locations (region of residence) were analyzed to determine their relationships to selected limitations among older people.

This study used logistic regression techniques to compare four groups of older people: (a) older people with no vision impairment or comorbid conditions, (b) older people with vision impairment only, (c) older people with comorbid conditions only, and (d) older people with both vision impairment and comorbid conditions. This study provides a demographic description of the age 55 years and above population, detailed descriptions of the conditions that contribute to vision impairment and health conditions among this population, and quantifies statistically significant predictors of selected mobility and vision activity limitations, and participation restrictions among these groups. As is described elsewhere, group D is compared to groups A, B, and C to determine the likelihood, reported as odds ratios, of people with vision impairment and comorbid conditions experiencing higher or lower likelihood of activity limitations.

This chapter presents the results for each of the research questions that guided this study. Criteria for the selection of the sample and coding of the independent and dependent variables are explained in the following and applies to all of the research questions. As described in Chapter Three, this study analyzed data from the 2008 NHIS (NCHS, 2009). These surveys include complex, multi-staged sample data and must be analyzed with statistical software and procedures that account for the multi-staged sampling design. These data were analyzed with SPSS, version 22 with complex sample module (IBM, 2013). These procedures provide correct standard errors and statistical probabilities for accurate inferential interpretation and estimated national prevalence totals. Because of the importance of standard errors in reporting findings from complex, multi-staged survey data, standard errors are reported for all results. Most complex survey analyses consider relative standard errors of < .30 benchmarks for unbiased statistical interpretations (CDC, 2015). Therefore, standard errors or confidence intervals are reported in this chapter for all results. In addition, accurate interpretations must be drawn from analyses sub-setting the sample population within the entire survey sample. The focal analyses for this study included older adults; therefore, data analyses were conducted for the entire population included in the data and older adults are identified as a subpopulation for each analysis. These procedures allowed for accurate consideration of the cluster sampling techniques used in surveying the sample population included in the NHIS data.

Control variables and comorbid/health conditions were identified through the literature review as outlined in Chapter Two and are described in the results for research question one. These variables were recoded into dichotomous variables for modeling as applicable to the specific research questions. Because the study focused on the relationship between vision impairment, comorbid conditions, and activity limitations or participatory restrictions, people self-reporting vision impairment and comorbid conditions were recoded into one of four mutually exclusive groups: (a) older people with no vision impairment or comorbid conditions, (b) older people with vision impairment only, (c) older people with comorbid conditions only, or (d) older people with vision impairment and comorbid conditions. Older adults with vision impairment and each specific comorbid/health condition are compared to each of the other groups for research questions two through five. In other words, the results are reported as how people with vision impairment and selected comorbid conditions are more or less likely to experience selected mobility and vision activity limitations, or participation restrictions than older adults with neither condition, vision impairment only, or the specified comorbid condition only.

Results of research question two, three, and four are reported first for the statistical significance of the four groups being compared, when controlling for sex, race/ethnicity, marital status, age, health status, and region of residence, contribute to the logistic regression model predicting the likelihood of difficulty performing selected mobility and vision activity limitations, or participation restrictions. These results are reported for the full-regression model and include, along with the standard errors (SE), the percent variance accounted for (Cox & Snell statistic), whether the vision/health variables, as a group, statistical significantly contribute to the dependent variable (Waldχ^2) , and the value of statistically significance (*p*). Along with the statistical significance of the vision impairment and comorbid condition, each of the three groups being compared with older people reporting vision impairment and comorbid conditions, the odds ratios, including confidence intervals, which indicate whether older people reporting vision and one of the selected comorbid conditions are more or less likely to report any degree of difficulty or the inability to perform selected nobilities, visual or participation activities, are reported, along with the strength of the contribution (Waldχ^2) and level of statistical significance (*p*).

Examination for Research Question 1

The first research question of this study asked: *What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations participation restrictions?* To guide the statistical analysis, this study considered the following hypothesis: *There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.* In examining Table 1, initial frequency analyses revealed there were an estimated 70.7 (Standard Error [SE] = .07) million non-institutionalized older adults in 2008. Of these, 45.5% (SE = .07) were male, and 54.5% (SE = .07) were female. Sixty percent (SE = .07) were married with their spouses living at home, .9% (SE = .01) married with their spouses not living at home, 17.8% (SE = .05) widowed, 12.1% (SE =

.04) divorced, 1.7% (SE = .02) separated, 4.8% (SE = .02) never married, 2.5% (SE = .02) living with a partner, and .2% (SE = <.01) reported an unknown marital status. Thirty-six percent (SE = .10) reported living in the South, 18.5% (SE = .07) lived in the Northeast, 23.7% (SE = .08) in the Midwest, and 21.8% (SE = .07) in the West. Race/ethnicity reveals 78.3% (SE = .06) were White non-Hispanic, 9.3% (SE = .07) African America, 7.7% (SE = .07) Hispanic, and 4.7% (SE = .07) reported an Other non-Hispanic category. Fifteen percent (SE = .07) of interviewees reported their health had improved in the past twelve months, 12% (SE = .07) reported their health has declined, and 73% (SE = .07) reported their health had remained the same in the past twelve months. These categorical variables were recoded into dichotomous variables for statistical analyses in research questions two through five. These were recoded as follows: married/not married, live in the South/other, White/Other Race/Ethnicity; however, health status was analyzed as included in the original data. The mean age of the sample population was 67.1 years old (SE = .07).

Table 1

Descriptive Characteristics of Older Adults

Variable		Population Estimates	UnWeighted	%	SE	CI LL	CI UL
Sex							
	Men	32,161,256	3,204	45.5	0.07	44.2	46.8
	Women	38,558,493	4,586	54.5	0.07	53.2	55.8
Marital Status							
	Married - at Home	42,412,859	3,490	60	0.7	58.6	61.3
	Married - not home	651,470	96	0.9	0.1	0.7	1.2
	Widowed	12,562,808	1,971	17.8	0.5	16.8	18.8
	Divorced	8,536,433	13,140	12.1	0.4	11.3	12.9
	Separated	1,185,114	199	1.7	0.2	1.4	2
	Never Married	3,412,349	540	4.8	0.2	4.4	5.3
	Partner	1,768,407	156	2.5	0.2	2.1	3
	Unknown	160,309	28	0.2	<.01	0.2	0.3
Region							
	Northeast	13,095,118	1,393	18.5	0.7	17.2	19.9
	Midwest	16,754,287	1,757	23.7	0.8	22.1	25.4
	South	25,487,905	2,875	36	1	34.1	38
	West	15,382,439	1,765	21.8	0.7	20.3	23.2
Race							
	White	55,384,966	5,462	78.3	0.6	77.1	79.5
	African American	6,546,246	1,108	9.3	0.4	8.5	10.1
	Hispanic	5,431,058	808	7.7	0.4	6.9	8.5
	Other	3,357,479	412	4.7	0.3	4.2	5.4
Health Status							
	Better	10,521,602	1,187	15	0.5	14.1	16
	Worse	8,407,494	972	12	0.5	11.1	12.9
	About the Same	51,274,803	5,569	73	0.6	71.8	74.3
Age*	mean = 67.16	70,719,749	7,790	100	0.141	66.88	67.44

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
*Age C.I. recorded as years; Sample Size recorded in Age
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Vision Impairment Characteristics

As shown in Table Two, the sample population included an estimated 11.32 million (16%, SE = .05) people reported trouble seeing, even when wearing glasses or contact lenses, and of those, an estimated 493,150 (4.4%, SE = .07) were blind. An estimated 943,126 (1.3%, SE = .03) had been told by a doctor or health care provider that they had diabetic retinopathy and, of those, an estimated 471,313 (52.3%, SE = .05) had lost vision because of diabetic retinopathy. An estimated 21.7 million (30.7%, SE = .07) had been told they had cataracts, and, of those, an estimated 5.1 million (24.1%, SE = .01) had lost vision because of cataracts, and an estimated 12.7 million (58.4%, SE = .01) had had cataract surgery. In addition, an estimated 3.95 million (1.3%, SE = .07) had been told they had glaucoma and, of those, an estimated 1.3 million (1.3%, SE = .07) had lost vision because of glaucoma. Moreover, an estimated 2.9 million (4.1%, SE = .03) had been told they had macular degeneration, and, of those, an estimated 1.5 million (52%, SE = 3.3) had lost vision because of macular degeneration. An estimated 61.8 million (88.1%, SE = .05) reported wearing glasses or contact lens lenses, and, of those, 55.1 million (89.4%, SE = .05) wear glasses or contact lens to read, write, cook, or sew, and an estimated 40.6 million (65.8%, SE = .08) wear glasses to drive, read signs, or watch TV. Of those reporting trouble seeing, even when wearing glasses or contact lens, 430,332 (3.8%, SE = .06) had used vision rehabilitation services, and an estimated 2.3 million (20.6%, SE = 1.4) used adaptive devices to increase or maintain independence.

Table 2

Characteristics of Vision Impairment Population

Variable	Population Estimate	UnWeighted	%	SE	CI LL	CI UL
Trouble See						
Yes	11,316,042	1,273	16	0.05	15.1	17
No	59,281,213	6,506	84	0.05	83	84.9
Blind[a]						
Yes	493,150	53	4.4	0.7	3.1	6
No	10,818,832	1,219	95.6	0.7	94	96.9
Diabetic Retinopathy						
Yes	943,126	117	1.3	0.1	1.1	1.7
No	69,536,408	7,642	98.7	0.1	98.3	98.9
Lost Vision - DR[b]	471,313	59	52.3	5.1	42.4	62
Cataracts						
Yes	21,668,957	2,493	30.7	0.7	29.5	32
No	48,833,905	5,272	69.3	0.7	68	70.5
Lost Vision - Cataract[b]	5,136,086	592	24.1	1..0	22.2	26.2
Cataract Surgery	12,659,215	1,478	58.4	1.1	56.2	60.6
Glaucoma						
Yes	3,953,069	495	5.6	0.3	5.1	6.2
No	66,430,451	7,257	64.4	0.3	93.8	94.9
Lost Vision - Glaucoma[b]	1,277,858	160	33.1	2.5	28.4	38.2
Macular Degeneration						
Yes	2,903,102	337	4.1	0.3	3.6	4.7
No	67,474,200	7447	95.9	0.3	95.3	96.4
Lost Vision - MD[b]	1,453,417	173	52	3.3	45.5	58.4
Wear Glasses						
Yes	61,801,820	6,714	88.1	0.5	87.1	89
No	8,362,546	1,013	11.9	0.5	11	12.9
Wear to Read/Write/Cook/Sew[c]						
Yes	55,173,517	6,001	89.4	0.5	88.4	90.2
No	6,574,438	707	10.6	0.5	9.8	11.6
Wear to Drive/Read Signs/Watch TV[a]						
Yes	40,603,232	4,400	65.8	0.8	64.2	67.3
No	21,130,236	2,305	34.2	0.8	32.7	35.8
Vision Rehab Services						
Yes	430,332	54	3.8	0.6	2.7	5.3
No	10,874,782	1,218	96.2	0.6	94.7	97.3

Table 2 (Continued)

Adaptive Devices[a]						
Yes	2,325,925	271	20.6	1.4	18	23.4
No	8,990,117	1,002	79.4	1.4	76.6	82

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
a = of those who self reported trouble seeing, even with glasses/contact lens
b = of those reporting specified visual condition; c = of the sample of adults (age 55 and above)
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Mobility Limitations

Table C1 shows nine selected mobility (ADL) limitations and includes estimated populations among all older adults. These questions were asked with respect to difficulty performing the activities without special equipment; therefore, each question is reported with the wording only including the activity in question. When asked about difficulty *walking ¼ of a mile*, an estimated 45.5 million (64.9%, SE = .07) reported no difficulty, 5.2 million (7.4%, SE = .04) a little difficulty, 4.5 million (6.4%, SE = .03) somewhat difficult, 3.9 million (5.6%, SE = .05) very difficult, 7.497 million (10.7%, SE = .05) could not do this at all, and 3.5 million (4.9%, SE = .03) did not do this activity.

When asked about their ability to *climb 10 steps*, an estimated 50.8 million (72.6%, SE = .06) reported no difficulty, 4.98 million (7.1%, SE = .03) a little difficulty, 3.89 million (5.6%, SE = .03) somewhat difficult, 3.37 million (4.8%, SE = .03) very difficult, 4.7 million (6.7%, SE = .03) could not do this at all, and 2.238 million (3.2%, SE = .02) did not do this activity.

When asked about their ability to *stand for two hours*, an estimated 43.4 million (62.0%, SE = .07) reported no difficulty, 5.21 million (7.5%, SE = .04) a little difficulty, 4.80 million (6.9%, SE = .03) somewhat difficult, 4.25 million (6.1%, SE = .03) very difficult, 8.99 million (12.9%, SE = .05) could not do this at all, and 3.303 million (4.7%, SE = .03) did not do this activity.

When asked about their ability to *sit for two hours*, an estimated 58.8 million (84.0%, SE = .05) indicated no difficulty, 3.73 million (5.0%, SE = .03) a little difficulty, 3.15 million (4.5%, SE = .03) somewhat difficult, 2.06 million (2.9%, SE = .02) very difficult, 1.46 million (2.1%, SE = .02) could not do this at all, and .773 million (1.1%, SE = .02) did not do this activity.

When asked about their ability to *stoop, bend, kneel*, an estimated 40.0 million (57.2%, SE = .03) reported no difficulty, 7.91 million (11.3%, SE = .04) a little difficulty, 7.71 million (11.0%, SE = .04) somewhat difficult, 6.62 million (9.5%, SE = .04) very difficult, 6.25 million (8.9%, SE = .04) could not do this at all, and 1.454 million (2.1%, SE = .02) did not do this activity.

When asked about their ability to *reach overhead*, an estimated 58.6 million (83.7%, SE = .05) reported no difficulty, 3.86 million (5.5%, SE = .03) a little difficulty, 3.35 million (4.8%, SE = .03) somewhat difficult, 2.03 million (2.9%, SE = .02) very difficult, 1.50 million (2.1%, SE = .02) could not do this at all, and .659 million (.09%, SE = .01) did not do this activity.

When asked about their ability to *grasp small objects*, an estimated 58.6 million (83.6%, SE = .05) reported no difficulty, 4.78 million (6.8%, SE = .03) a little difficulty, 3.89 million (5.6%, SE = .03) somewhat difficult, 1.70 million (2.4%, SE = .02) very difficult, 4.13 million (5.9%, SE = .03) could not do this at all, and 2.136 million (3.0%, SE = .02) did not do this activity.

When asked about their ability to *lift or carry ten pounds*, an estimated 54.0 million (78.2%, SE = .06) reported no difficulty, 3.61 million (5.2%, SE = .03) a little difficulty, 3.23 million (4.6%, SE = .03) somewhat difficult, 2.14 million (3.1%, SE = .02) very difficult, 4.13 million (5.9%, SE = .03) could not do this at all, and 2.136 million (3.0%, SE = .02) did not do this activity.

When asked about their ability to *push large objects*, an estimated 49.1 million (70.2%, SE = .07) reported no difficulty, 4.30 million (6.1%, SE = .03) a little difficulty, 3.42 million (4.9%, SE = .03) somewhat difficult, 2.14 million (3.1%, SE = .03) very difficult, 6.12 million (8.8%, SE = .04) could not do this at all, and 4.682 million (6.7%, SE = .04) did not do this activity.

Given the distribution for these activity limitations, two measures were identified as representative measures of the degrees of difficulty among older adults. Difficulty stooping, bending, or kneeling revealed the largest estimated numbers of people indicating difficulty; therefore, this variable was selected as one of the dependent variables to model mobility limitations. In addition, walking one-quarter of a mile reflects the combination of balance, stamina, and coordinated movements necessary for mobility; therefore, this variable was chosen as the second dependent variable to model for the functional ADL measures. These variables were recoded into dichotomous variables with one indicating no difficulty and two indicating any degree of difficulty.

Vision Activity Limitations

Table C2 shows responses to questions regarding vision activity or near vision tasks. These questions were asked with respect to difficulty performing the task without special equipment; therefore, each question is reported with the wording only including the task in question. When asked about difficulty *reading the newspaper,* an estimated 54.9 million (78.9%, SE = .06) reported no difficulty, 7.7 million (11.1%, SE = .05) a little difficulty, 3.9 million (5.6%, SE = .03) somewhat difficult, 2.10 million (3.0%, SE = .02) very difficult, .740 million (1.1%, SE = .01) could not do this at all, and .497 million (.7%, SE = .01 did not do this activity.

When asked about their ability to *see up close, cook, or sew*, an estimated 57.0 million (88.1%, SE = .05) reported no difficulty, 6.09 million (8.7%, SE = .04) a little difficulty, 3.60 million (5.2, SE = .03) somewhat difficult, 1.38 million (2.0%, SE = .02) very difficult, .679 million (1.0%, SE = .01) could not do this at all, and 1.18 million (1.7%, SE = .02) did not do this activity.

When asked about *going down stairs*, an estimated 59.2 million (84.7%, SE = .05) reported no difficulty, 4.09 million (5.9%, SE = .03) a little difficulty, 2.45 million (3.5%, SE = .02) somewhat difficult, 1.67 million (2.4%, SE = .02) very difficult, .411 million (.6%, SE = .01) could not do this at all, and 2.052 million (2.9%, SE = .02) did not do this activity.

When asked about the ability to *drive during the daytime*, *even when wearing glasses or contact lens,* an estimated 60.2 million (86.0%, SE = .05) reported no difficulty, 1.37 million (2.0%, SE = .02) a little difficulty, .748 million (1.1%, SE = .01) somewhat difficult, .358 million (.5%, SE = .01) very difficult, .726 million (1.0%, SE = .01) could not do this at all, and 6.55 million (9.4%, SE = .04) they did not do this activity.

When asked about their ability to *notice objects while walking,* a measure of peripheral function, an estimated 63.9 million (91.5%, SE = .03) reported no difficulty, 2.04 million (2.9%, SE = .02) a little difficulty, 1.65 million (2.4%, SE = .02) somewhat difficult, .813 million (1.2%, SE = .01) very difficult, .381 million (.50%, SE = .01) could not do this at all, and 1.007 million (1.4%, SE = .02) did not do this activity.

When asked about their ability to *find something on a crowded shelf,* an estimated 63.3 million (90.7%, SE = .04) reported no difficulty, 2.86 million (4.1%, SE = .03) a little difficulty, 1.82 million (2.4%, SE = .02) somewhat difficult, .840 million (1.2%, SE = .01) very difficult, .309 million (.40%, SE = .01) could not do this at all, and .65 million (.9%, SE = .01) did not do this activity.

Given the distribution for these vision activity measures, one measure was identified as a representative measure of the degree of difficulty among older people. Difficulty reading revealed the largest estimated numbers of people indicating difficulty; therefore, this variable was selected as the dependent variable to model visual activity limitations. This variable was recoded into a dichotomous variable with one indicating no difficulty and two indicating any degree of difficulty.

Participation Restrictions

Table C3 shows the results of three social participation restrictions. These questions were asked with respect to difficulty performing participation activities without special equipment; therefore, each question is reported with the wording only including the activity in question. When asked about their ability to *go out to special events without special equipment*, an estimated 55.8 (79.7%, SE = .06) reported no difficulty, 3.51 million (5.0%, SE = .03) a little difficulty, 3.5 million (5.0%, SE = .03) somewhat difficult, 2.08 million (3.0%, SE = .02) very difficult, 2.51 million (3.6%, SE = .03) could not do this at all, and 2.60 million (3.7%, SE = .03) did not do this activity.

When asked about their ability *to participate in social events*, an estimated 58.0 million (82.8%, SE = .50 reported no difficulty, 2.59 million (3.7%, SE = .03) a little difficulty, 2.44 million (3.5%, SE = .02) somewhat difficult, 1.65 million (2.4%, SE = .02) very difficult, 2.24 million (3.2%, SE = .03) could not do this at all, and 3.1 million (4.4%, SE = .03) did not do this activity. Finally, when asked about their ability to *relax at home*, an estimated 65.3 million (93.2%, SE = .03) reported no difficulty, 2.09 million (3.0%, SE = .02) a little difficulty, 1.29 million (1.9%, SE = .02) somewhat difficult, .615 million (0.9%, SE = .01) very difficult, .364 million (0.5%, SE = .01) could not do this at all, and .368 million (0.5%, SE = .01) did not do this activity.

Given the distribution for these social participation measures, one measure was identified as a representative measure of the degree of difficulty for social participation among older adults. Difficulty going out without special equipment revealed the largest estimated numbers of people indicating difficulty; therefore, this variable was selected as the dependent variable to model social participation. This variable was recoded into a dichotomous variable with one indicating no difficulty and two indicating any degree of difficulty.

Vision Impairment and Comorbid Condition Prevalence

Table C4 shows the prevalence of eleven comorbid conditions coupled with vision impairment. Missing values are not reported and are accounted for in the confidence intervals, which are omitted in the narrative. The stem for each question asks, "*Has a doctor or other health care provider told you that you have* . . . ? The 11 conditions include hypertension, coronary heart disease, heart condition, stroke, emphysema, asthma, cancer, diabetes, depression, arthritis, and hearing impairment. An estimated 27.0 million (38.3%, SE = .06) people have neither vision impairment nor hypertension, 4.1 million (5.8%, SE = .03) have vision impairment only, 32.3 million (45.7%, SE = .06) have hypertension, and 7.2 million (10.2%, SE = .04) report hypertension and vision impairment. In addition, 53.1 million (75.4%, SE = .06) older people have neither coronary disease nor vision impairment, 9.5 million (13.5%, SE = .04) have vision impairment only, 6.1 million (8.7%, SE = .04) have coronary disease only, and 1.8 million (2.5%, SE = .02) have both conditions. When comparing older people who have heart disease and vision impairment, an estimated 51 million (72.2%, SE = .06) have neither condition, 8.8 million (12.4%, SE = .04) have vision impairment only, 8.4 million (11.8%, SE = .04) have heart disease only, and 2.5 million (3.6%, SE = .03) have both conditions. Moreover, an estimated 55.8 million (79.1%, SE = .05) have neither stroke nor vision impairment, 9.9 million (14.0%, SE = .05) have vision impairment only, 3.5 million (4.9%, SE = .03) have a stroke only, and 1.4 million (2.0%, SE = .02) have both conditions. When comparing older people who have emphysema and vision impairment, an estimated 57.3 million (81.1%, SE = .05) have neither condition, 10.4 million (14.8%, SE = .05) have vision impairment only, 2.1 million (3.0%, SE = .02) have emphysema only, and 0.827 million (1.2%, SE = .01) have both conditions. When comparing older adults, who have asthma and vision impairment, an estimated 53.1 million (75.1%, SE = .06) have neither condition, 9.5 million (13.4%, SE = .04) have vision impairment only, 6.3 million (8.9%, SE = .04) have asthma only, and 1.9 million (2.6%, SE = .02) have both conditions. When comparing older adults, who have diabetes and vision impairment, an estimated 48.8 million (70.5%, SE = .06) have neither condition, 8.4 million (12.1%, SE = .04) have vision impairment only, 9.3 million

(13.4%, SE = .04) have diabetes only, and 2.7 million (4.0%, SE = .02) have both conditions. When comparing older adults, who have arthritis and vision impairment, an estimated 34.30 million (48.6%, SE = .07) have neither condition, 4.6 million (6.5%, SE = .03) have vision impairment only, 24.99 million (35.4%, SE = .06) have arthritis only, and 6.69 million (9.5%, SE = .04) have both conditions. When comparing older adults, who have depression and vision impairment, an estimated 43.89 million (62.8%, SE = .07) have neither condition, 6.12 million (8.8%, SE = .04) have vision impairment only, 14.8 million (21.2%, SE = .06) have depression only, and 4.72 million (6.7%, SE = .03) have both conditions. When comparing older adults, who have hearing and vision impairment, an estimated 43.7 million (61.8%, SE = .07) have neither condition, 6.59 million (9.3%, SE = .04) have vision impairment only, 15.7 million (22.2%, SE = .06) have hearing loss only, and 4.7 million (6.7%, SE = .03) have both conditions.

These vision and comorbid conditions are the focal groups that were compared in this study. As reported elsewhere, the odds ratios among people reporting health related conditions and vision impairment were compared to the other three groups in this study.

Research question one also examined the independent variables that were used as control variables in these analyses. Because there is a dearth of literature examining the effect of geographic residence, research question one considered the effect of region along with the other control variables. These results are illustrated in Table Three, which presents a base and full logistic regression model examining the odds of self-reporting trouble seeing, even when wearing glasses or contact lenses. The full model revealed an increase of three percent in the classification table (81% vs 84%) and an increase in the percent variance accounted for in the model (.001% vs 2.5%, Cox & Snell). However, region of residence was not statistically significant when examined alone or when controlling for other independent variables.

Table 3

Logistic Regression: Vision Loss by Region

Variable		Odds	Std. Error	t	p	Wald	p	Cox & Snell
Base Model								0.001
Regions[a]						0.721	0.54	
	Northeast	0.947	0.115	0.470	0.638			
	Midwest	1.031	0.111	-0.272	0.785			
	South	1.087	0.084	-0.931	0.353			
Predicted Correct = 81%								
Full Model								2.50%
Regions[a]						0.637	0.592	
	Northeast	0.949	0.114	-0.456	0.649			
	Midwest	1.073	0.109	0.647	0.518			
	South	1.079	0.089	0.850	0.396			
	Male	0.746	0.074	-3.967	< .001	15.737	< .001	
Health						42.44	< .001	
	Health Better	1.288	0.102	2.740	<.05			
	Health Worse	2.415	0.096	9.196	< .001			
	White: Non-H	0.776	0.078	-1.257	0.21	1.581	0.21	
	Not-Married	1.555	0.078	2.445	<.05	5.976	<.01	
	Age	1.046	0.004	4.216	< .001	17.776	< .001	
Predicted Correct = 84%								

Note. Baseline Groups = Western Region; Female; Same Health; Other Race; Not Married; Other Region. Mean Age = 67.15. Degrees of Freedom = 300. a = OR reverse computed for baseline compairson
Strata = 300, PSU Units = 600
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Examination of Research Question 2

Research question two asked: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?* In examining research question two, two sets of eleven logistic regression procedures were used to test the following hypothesis: whether older adults self-reporting vision impairment and selected health comparisons would be more likely to report any difficulty in performing selected mobility functions. As described in the results revealed in research question one, *difficulty stooping, bending, or kneeling* was selected as one of the mobility limitation dependent variables for testing the hypothesis associated with this research question. The hypothesiss for research question two was: *Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.* In addition, *difficulty walking ¼ mile* was selected as a dependent variable for a second set of logistic regression models because of the fundamental nature of walking in independent living activities. Results for any difficulty stooping, bending, or kneeling without special equipment are reported first and are followed with the results for older people reporting any difficulty walking ¼ mile.

Difficulty Stooping, Bending, or Kneeling

In reviewing the results indicated in Table D1, these models indicated whether the combinations of vision impairment and comorbid health comparisons significantly predicted people's difficulty stooping, bending, or kneeling. The results of the full regression model comparing people reporting vision impairment and being told they had hypertension with the other comparison groups correctly predicted 81.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.6% of the variance (Cox & Snell = .166, Wald $\chi^2 = 101.45$, ($p = < .001$). Specific comparisons revealed people reporting both comparisons were 6.45 times as likely to report any difficulty stooping, bending, or kneeling than people reporting neither comparison 95% CI [5.15, 8.13], ($p = < .001$), 2.24 times as likely to report difficulty stooping, bending, or kneeling than people reporting vision impairment only 95% CI [1.65, 3.03], ($p = < .001$), and were 3.07 times as likely to report any difficulty stooping, bending, or kneeling than older people having hypertension only 95% CI [2.47, 3.83], ($p = < .001$).

The results of the full regression model comparing vision impairment and having coronary heart disease with the other comparison groups correctly predicted 68.0% of the outcome variable, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.0% of the variance (Cox & Snell = .150, Wald $\chi^2 = 82.34$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 6.49 times as likely to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [4.08, 10.31], ($p = < .001$), 2.19 times as likely, to report difficulty stooping, bending, or kneeling than older people reporting vision impairment only 95% CI [1.34, 3.57], ($p = <.01$), and were 3.31 times as likely to experience any difficulty stooping, bending, or kneeling as people having coronary heart disease only 95% CI [1.97, 5.52], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and a heart condition compared with the other comparison groups correctly predicted 61.0% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.2% of the variance (Cox & Snell = .152, Wald $\chi^2 = 87.26$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 5.37 times as likely as to report any difficulty stooping, bending, or kneeling than older people reporting neither condition 95% CI [3.71, 7.75], ($p = < .001$), 1.79 times as likely to report difficulty stooping, bending, or kneeling than older people reporting vision impairment only 95% CI [1.17, 2.74], ($p = <.01$), and were 2.79 times as likely to report any difficulty stooping, bending, or kneeling as older people with a heart condition only 95% CI [1.85, 4.17], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and stroke compared with the other comparison groups correctly predicted 67.8% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.1% of the variance, (Cox & Snell = .151, Wald $\chi^2 = 83.13$, $p = < .001$). Specific comparisons revealed people reporting both conditions were 8.13 times as likely as to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [4.76, 13.89], ($p = < .001$), 2.76 times as likely to report difficulty stooping, bending, or kneeling than people reporting vision impairment only 95% CI [1.59, 4.78], ($p = < .001$), and were 3.16 times as likely to report any difficulty stooping, bending, or kneeling as people with stroke only 95% CI [1.75, 5.68], ($p = < .001$).

The results of the full regression model comparing people reporting vision impairment and emphysema compared with the other comparison groups correctly predicted 67.8% of the outcome variable, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.9% of the variance (Cox & Snell = .149, Wald $\chi^2 = 70.757$, $p = < .001$). Specific comparisons revealed people reporting both conditions were 11.36 times as likely as to report any difficulty stooping, bending, or kneeling than older people reporting both conditions 95% CI [4.76, 27.03], ($p = <$ .001), 3.83 times as likely to report difficulty stooping, bending, or kneeling without special equipment than people reporting vision impairment only 95% CI [1.59, 4.78], ($p = <.01$), and were 4.92 times as likely to report any difficulty stooping, bending, or kneeling as older people reporting emphysema only 95% CI [1.95, 12.50], ($p = <.01$).

The results of the full regression model comparing people reporting vision impairment and asthma when compared with the other comparison groups correctly predicted 67.6% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.2% of the variance, (Cox & Snell = .152, Wald$\chi^2 = 76.69$, $p = < .001$). Specific comparisons revealed people reporting both conditions were 7.52 times as likely as to report any difficulty stooping, bending, or kneeling than people with both conditions 95% CI [4.67, 12.05], ($p = < .001$), 2.59 times as likely to report difficulty stooping, bending, or kneeling than people reporting vision impairment only, 95% CI [1.56, 2.31], ($p = < .001$), and were 3.85 times as likely to experience any difficulty stooping, bending, or kneeling as older people reporting asthma only 95% CI [2.33, 6.33], ($p = < .001$).

The results of the full regression model comparing people reporting vision impairment and cancer with the other comparison groups correctly predicted 81.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.7% of the variance, (Cox & Snell = .144, Wald $\chi^2 = 62.36$, $p = < .001$). Specific comparisons revealed people reporting both conditions were 3.95 times as likely as to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [2.71, 5.75], ($p = < .001$), 1.32 times as likely, though not statistically significantly more likely, to report difficulty stooping, bending, or kneeling than people reporting vision impairment only 95% CI [.86, 2.02], ($p = 0.192$), and were 3.36 times as likely to report any difficulty stooping, bending, or kneeling as older people reporting cancer only 95% CI [2.25, 5.05], ($p = <$ .001).

The results of the full regression model comparing people reporting vision impairment and diabetes with the other comparison groups correctly predicted 69.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.7% of the variance (Cox & Snell = .167, Wald $\chi^2 = 108.81$, $p = < .001$). Specific comparisons revealed people reporting both comparisons were 7.19 times as likely to report any difficulty stooping, bending, or kneeling without special equipment than people reporting neither condition 95% CI [5.00, 10.31], ($p = < .001$), 2.40 times as likely to report difficulty stooping, bending, or kneeling than people reporting vision impairment only 95% CI [1.59, 3.61], ($p = < .001$), and were 2.64 times as likely to experience any difficulty stooping, bending, or kneeling as people reporting diabetes only 95% CI [1.81, 3.93], ($p = < .001$).

The results of the full regression model comparing people reporting vision impairment and arthritis with the other comparison groups correctly predicted 71% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 21.9% of the variance, (Cox & Snell = .219, Waldχ^2 = 251.092, p = < .001). Specific comparisons revealed people reporting both conditions were 10.87 times as likely as to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [8.70, 13.70], (p = < .001), 3.72 times as likely to report difficulty stooping, bending, or kneeling than older people reporting vision impairment only 95% CI [2.68, 5.18], (p = < .001), and were 2.67 times as likely to experience any difficulty stooping, bending, or kneeling than older people reporting arthritis only 95% CI [2.10, 3.37], (p = < .001).

The results of the full regression model comparing people reporting vision impairment and being told they had depression with the other comparison groups correctly predicted 68.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.2% of the variance, (Cox & Snell = .162, Wald χ^2 = 94.860, p = < .001). Specific comparisons revealed people reporting both conditions were 5.21 times as likely as to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [3.97, 6.85], (p = < .001), 1.75 times as likely to report difficulty stooping, bending, or kneeling than people reporting vision impairment only 95% CI [1.21, 2.50], (p = <.01), and were 2.36 times as likely to report any difficulty stooping, bending, or kneeling than older people reporting depression only 95% CI [1.79, 3.13], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and older people reporting trouble hearing, with the other comparison groups correctly predicted 78.9% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.5% of the variance, (Cox & Snell = .155, Wald χ^2 = 88.265, p = < .001). Specific comparisons revealed people reporting both conditions were 5.13 times as likely as to report any difficulty stooping, bending, or kneeling than people reporting neither condition 95% CI [4.00, 6.58], (p = < .001), 1.78 times as likely to report difficulty stooping, bending, or kneeling than older people reporting vision impairment only 95% CI [1.30, 2.43], (p = < .001), and were 2.80 times as likely to report any difficulty stooping, bending, or kneeling as older people reporting trouble hearing only 95% CI [2.146, 3.67], (p = < .001).

Difficulty Walking ¼ Mile

In reviewing Table D2, these models indicate whether the combinations of vision impairment, and selected comorbid conditions significantly predicted older people's difficulty walking ¼ mile. The results of the full regression model comparing older people reporting vision impairment and having hypertension with the other comparison groups correctly predicted 73.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 19.8% of the variance, (Cox & Snell = .198, Wald χ^2 = 94.264, p = < .001). Specific comparisons revealed people reporting both conditions were 5.85 times as likely as to report any difficulty walking ¼ mile than older people reporting neither condition 95% CI 4.71, 7.25], (p = < .001), 2.25 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only, 95% CI [1.65, 3.08], (p = < .001), and were

2.80 times as likely to report any difficulty walking ¼ mile as older people reporting hypertension only 95% CI [2.27, 3.48], (p = < .001).

The results of the full regression model comparing older people reporting having vision impairment and coronary heart disease with the other comparison groups correctly predicted 73.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 19.7% of the variance (Cox & Snell = .197, Wald χ^2 = 94.140, p = < .001). Specific comparisons revealed older people reporting both conditions were 9.01 times as likely to report any difficulty walking ¼ mile than older people reporting neither comparison 95% CI [5.68, 14.29], (p = < .001), 3.34 times as likely to report difficulty walking ¼ mile than people reporting vision impairment only 95% CI [2.05, 5.43] p = < .001), and were 3.05 times as likely to report any difficulty walking ¼ mile as people reporting coronary heart disease only 95% CI [1.83, 5.10], (p = < .001).

The results of the full regression model comparing people reporting vision impairment and a heart condition with other comparison groups correctly predicted 72.9% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 18.8% of the variance (Cox & Snell = .188, Wald χ^2 = 74.00, p = < .001). Specific comparisons revealed people reporting both conditions were 4.52 times as likely as to report any difficulty walking ¼ mile than people reporting neither condition 95% CI [3.30, 6.21], (p = <.05), 1.60 times as likely, though not statistically significantly more likely, to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [1.12, 2.29], (p = <.05), and were

3.05 times as likely to experience any difficulty walking ¼ mile as people reporting a heart condition only 95% CI [1.83, 5.10], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and older people having a stroke with the other comparison groups correctly predicted 71.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 19.7% of the variance, (Cox & Snell = .197, Wald χ^2 = 94.14, p = < .001). Specific comparisons revealed people reporting both comparisons were 7.81 times as likely as to report any difficulty walking ¼ mile than people reporting neither condition 95% CI [4.50, 13.51], (p = < .001), 2.80 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [1.56, 5.03], (p = <.01), and were 1.82 times as likely, though not statistically significantly more likely, to experience any difficulty walking ¼ mile as people having a stroke only 95% CI [2.10, 3.37], (p = 0.056).

The results of the full regression model comparing older people reporting vision impairment and emphysema with other comparison groups correctly predicted 72.9% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 19.1% of the variance, (Cox & Snell = .191, Wald χ^2 = 81.65, p = < .001). Specific comparisons revealed older people reporting both conditions were 7.93 times as likely as to report any difficulty walking ¼ mile than older people reporting neither condition 95% CI [3.76, 16.67], (p = < .001), 2.82 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only , 95% CI [1.31, 6.06], (p = <.01), and were 1.79 times as likely, though not statistically significantly more likely, to report any difficulty walking ¼ mile as older people reporting emphysema only 95% CI [.79, 40.05], (p = 0.162).

The results of the full regression model comparing older people reporting vision impairment and asthma with the other comparison groups correctly predicted 71.7% of the outcome variables, indicated the predictors, as a group, statistically significantly contributed to the model, and explained 18.4% of the variance (Cox & Snell = .184, Wald χ^2 = 60.184, p = < .001). Specific comparisons revealed older people reporting both conditions were 5.18 times as likely to report any difficulty walking ¼ mile than older people reporting neither condition 95% CI [3.33.8.06] , (p = < .001), 1.92 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [1.21, 3.04], (p = <.01), and were 3.05 times as likely to report any difficulty walking ¼ mile as older people reporting asthma only 95% CI [1.94, 4.80], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and having cancer correctly predicted 81.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 18.0% of the variance, (Cox & Snell = .180, Wald χ^2 = 57.613, p = < .001). Specific comparisons revealed older people reporting both comparisons were 3.16 times as likely as to report any difficulty walking ¼ mile than older people reporting neither condition 95% CI [2.32, 4.31], (p = < .001), 1.34 times as likely, though not statistically significantly more likely, to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [0.79, 1.63], (p = 0.479), and were 2.88 times as likely to report any difficulty walking ¼ mile as older people having cancer only 95% CI [2.0.6, 4.03], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and diabetes with the other comparison groups correctly predicted 73.6% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 20.2% of the variance (Cox & Snell = .202, Wald $\chi^2 = 89.855$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 7.14 times as likely to report any difficulty walking ¼ mile than older people reporting neither comparison 95% CI [5.03, 10.20], ($p = < .001$), 2.68 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [1.83, 3.92], ($p = < .001$), and 2.63 times as likely to experience any difficulty walking ¼ mile as people reporting diabetes only 95% CI [1.81, 3.85], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and having arthritis with other comparison groups correctly predicted 74.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 22.1% of the variance, (Cox & Snell = .221, Wald $\chi^2 = 153.496$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 7.81 times as likely to report any difficulty walking ¼ mile than older people reporting neither conditions 95% CI [3.21, 9.80], ($p = < .001$), 3.18 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [2.27, 4.49], ($p = < .001$), and were 2.62 times as likely to report any difficulty walking ¼ mile than older people having arthritis only 95% CI [2.10, 3.26], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and having depression with the other comparison groups correctly predicted 72.5% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 18.8% of the variance (Cox & Snell = .188, Wald χ^2 = 77.052, p = < .001). Specific comparisons revealed older people reporting both conditions were 4.25 times as likely as to report any difficulty walking ¼ mile than older people reporting neither conditions 95% CI [3.30, 5.46], (p = < .001), 1.53 times as likely to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [1.10, 2.12], (p = <.05), and were 2.34 times as likely to report any difficulty walking ¼ mile than older people having arthritis only 95% CI [1.79, 3.05], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and older people reporting trouble hearing correctly predicted 72.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 18.3% of the variance (Cox & Snell = .183, Wald χ^2 = 64.81, p = < .001). Specific comparisons revealed older people reporting both conditions were 3.43 times as likely as to report any difficulty walking ¼ mile than older people reporting neither conditions 95% CI [2.73, 4.31], (p = < .001), 1.18 times as likely, though not statistically significantly more likely, to report difficulty walking ¼ mile than older people reporting vision impairment only 95% CI [0.87, 1.61], (p = 0.281), and were 2.35 times as likely to report any difficulty walking ¼ mile as older people having trouble hearing only 95% CI [1.80, 3.09], (p = < .001).

Examination of Research Question 3

Research question three asked: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?* The hypothesis for research question three was: *Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.* In examining research question three, eleven logistic regression procedures were used to test whether older adults self-reporting vision impairment and selected comorbid comparisons were more likely to report any difficulty in reading when compared to older adults who reported no vision impairment or comorbid comparison, vision impairment only, or one of the selected comorbid comparisons. As described in research question one, *difficulty reading* was selected as the visual activity limitation dependent variable for testing the hypothesis associated with this research question. In reviewing the results indicated in Table D3, these models indicated whether the combinations of vision impairment and comorbid comparisons significantly predicted older people's difficulty reading.

Difficulty Reading

The results of the full regression model comparing older people reporting vision impairment and hypertension correctly predicted 81.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.7% of the variance (Cox & Snell = .147, Wald $\chi^2 = 214.96$, $p = < .001$).

Specific comparisons revealed older people reporting both conditions were 9.09 times as likely as to report any difficulty reading than older people reporting neither conditions 95% CI [7.24, 11.36] , (*p* = < .001), 1.30 times as likely, though not statistically significantly more likely, to report difficult reading than older people reporting vision impairment only 95% CI 0.97, 1.76] , (*p* = 0.83), and were 9.09 times as likely to report any difficulty reading as older people reporting hypertension only 95% CI [7.35, 11.36] , (*p* = < .001).

The results of the full regression model comparing vision impairment and coronary heart disease correctly predicted 81.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.3% of the variance (Cox & Snell = .143, Wald χ^2 = 218.63, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 9.62 times as likely to report any difficulty reading than older people reporting neither condition 95% CI [6.67, 13.70] , *p* = < .001), 1.18 times as likely, though not statistically significantly more likely, to report any difficulty reading than older people reporting vision impairment only 95% CI [0.79, 1.74], (p = 0.411), and were 8.33 times as likely to report any difficulty reading as older people reporting coronary heart disease only 95% CI [5.55, 12.50, (*p* = < .001).

The results of the full regression model comparing vision impairment and older people reporting a heart condition correctly predicted 81.0% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.9% of the variance (Cox & Snell = .149, Wald χ^2 = 216.63, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 8.62 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [6.25, 11.90] , (*p* = < .001), 1.04 times as likely, though not statistically significantly more likely, to report difficulty reading than older people reporting vision impairment only 95% CI [0.74, 1.47] , (*p* = 0.788), and were 8.26 times as likely to report any difficulty reading as older people reporting a heart condition only 95% CI [5.74, 11.90] , (*p* = < .001).

The results of the full regression model comparing vision impairment and older people reporting a stroke correctly predicted 81.2% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.8% of the variance, (Cox & Snell = .148, Wald χ^2 = 22.35, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 12.67 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [5.54, 18.87] , (*p* = < .001), 1.56 times as likely to report any difficulty reading than older people reporting vision impairment only 95% CI [1.03, 2.34], (*p* = <.05), and were 8.20 times as likely to report any difficulty reading as older people reporting a stroke only 95% CI [5.15, 12.99], (*p* = < .001).

The results of the full regression model comparing older people reporting vision impairment and emphysema correctly predicted 81.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.1% of the variance (Cox & Snell = .141, Wald χ^2 = 215.27, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 15.87 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [8.19, 30.30], (*p* = < .001), 1.96 times as likely to report difficulty reading than older people reporting vision impairment only 95% CI [1.202, 3.78], (p = <.05), and were 11.36 times as likely to experience any difficulty reading as older people reporting emphysema only 95% CI [5.34, 23.81], p = < .001).

The results of the full regression model comparing older people reporting vision impairment and asthma correctly predicted 81.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.7% of the variance (Cox & Snell = .147, Wald χ^2 = 298.00, p = < .001). Specific comparisons revealed older people reporting both conditions were 9.90 times as likely to report any difficulty reading than older people reporting neither condition 95% CI [6.75, 14.71], (p = < .001), 1.24 times as likely, though not statistically significantly more likely, to report difficulty reading than older people reporting vision impairment only, 95% CI [0.82, 1.85], (p = <.309), and were 9.62 times as likely to report any difficulty reading as older people reporting asthma only 95% CI [6.21, 14.92], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and cancer correctly predicted 81.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.7% of the variance (Cox & Snell = .147, Wald χ^2 = 224.53, p = < .001). Specific comparisons revealed older people reporting both conditions were 9.26 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [6.85, 12.50], (p = < .001), 1.17 times as likely, though not statistically significantly more likely, to report any difficulty reading than older people reporting vision impairment only 95% CI [0.83, 1.64], (p = 0.369), and were 9.99 times as likely to report any difficulty reading as older people reporting cancer only 95% CI [7.09, 13.89], (p = < .001).

The results of the full regression model comparing older people reporting vision impairment and diabetes correctly predicted 81.6% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.9% of the variance (Cox & Snell = .149, Wald $\chi^2 = 299.00$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 11.63 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [8.33, 16.39], ($p = < .001$), 1.44 times as likely to report any difficulty reading than older people reporting vision impairment only 95% CI [6.06, 12.82], ($p = <.05$), and were 11.372 times as likely to report any difficulty reading as older people reporting diabetes only 95% CI [6.06, 12.82], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and arthritis correctly predicted 81.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.7% of the variance (Cox & Snell = .147, Wald $\chi^2 = 219.006$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 9.09 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [7.24, 11.36], ($p = < .001$), 1.09 times as likely, though not statistically significantly more likely, to report any difficulty reading than older people reporting vision impairment only 95% CI [0.81, 1.46], ($p = 0.562$), and were 7.99 times as likely to report any difficulty reading than older people reporting arthritis only 95% CI [6.37, 10.00], ($p = < .001$).

The results of the full regression model comparing older people reporting vision impairment and depression correctly predicted 81.4% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 14.8% of the variance (Cox & Snell = .148, Wald $\chi^2 = 225.514$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 10.41 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [8.26, 12.99], ($p = < .001$), 1.32 times as likely to report any difficulty reading than older people reporting vision impairment only 95% CI [1.01, 1.75], ($p = <.05$), and were 6.58 times as likely to report any difficulty reading than older people reporting arthritis only 95% CI [6.58, 10.87], ($p = < .001$).

The results of the full regression model comparing vision impairment and older people reporting trouble hearing correctly predicted 81.9% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 15.0% of the variance (Cox & Snell = .150, Wald $\chi^2 = 81.25$, $p = < .001$). Specific comparisons revealed older people reporting both conditions were 11.49 times as likely as to report any difficulty reading than older people reporting neither condition 95% CI [8.93, 7.69], ($p = < .001$), 1.42 times as likely to report difficulty reading than older people reporting vision impairment only 95% CI [1.06, 1.89], ($p = < .001$), and were 7.69 times as likely to experience any difficulty reading as older people reporting trouble hearing only 95% CI [5.88,10.10], ($p = < .001$).

Examination of Research Question 4

Research question four asked: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?* The hypothesis for research question four was:

Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

In examining research question four, eleven logistic regression procedures were used to test if older adults self-reporting vision impairment and selected comorbid conditions were more likely to report any difficulty in a selected participation restriction when compared to older adults who reported no vision impairment or comorbid conditions, vision impairment only, or one of the selected comorbid conditions. As described in the results for research question one, *difficulty going out* was selected as the dependent variable for testing the hypothesis associated with this research question. In reviewing the results indicated in Table D4, these models indicated the combinations of health comparisons and vision impairment significantly predicted older people's difficulty in going out.

The results of the full regression model comparing vision impairment and hypertension correctly predicted 81.9% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.8% of the variance (Cox & Snell = .168, Wald $\chi^2 = 75.23$, p = < .001). Specific comparisons revealed older people reporting both conditions were 5.38 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [4.27, 6.75], (p = < .001), 1.56 times as likely to report difficulty going out than older people reporting vision impairment only 95% [CI 1.15, 2.05], (p = <.01), and were 3.39 times as likely to report any difficulty going out as older people reporting hypertension only 95% CI [2.77, 4.67] , (p = < .001).

The results of the full regression model comparing vision impairment and coronary heart disease correctly predicted 82.5% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 17.4% of the variance (Cox & Snell = .174, Wald χ^2 = 97.13, p = < .001). Specific comparisons revealed older people reporting both conditions were 8.62 times as likely to report any difficulty going out than older people reporting neither condition 95% CI [5.64, 13.15], (p = < .001), 2.50 times as likely to report difficulty going out than older people reporting vision impairment only 95% CI [1.62, 2.85], (p = < .001), and were 3.22 times as likely to experience any difficulty going out as older people reporting coronary heart disease only 95% CI [2.04, 5.05], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting being told they had heart disease correctly predicted 82.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 17.2% of the variance, (Cox & Snell = .174, Wald χ^2 = 97.13, p = < .001). Specific comparisons revealed older people reporting both conditions were 5.71 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [4.04, 8.06], (p = < .001), 1.55 times as likely to report any difficulty going out than older people reporting vision impairment only 95% CI [1.08, 2.22] , (p =<.05), and were 2.72 times as likely to experience any difficulty going out as older people reporting heart disease only 95% CI [1.74, 3.64], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting being told they had had a stroke correctly predicted 82.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 17.9% of the variance (Cox & Snell = .179, Wald $\chi^2 = 98.37$, p = < .001). Specific comparisons revealed older people reporting both conditions were 10.31 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [6.53, 16.39], (p = < .001), 2.94 times as likely to report any difficulty going out than older people reporting vision impairment only 95% CI [1.82, 2.76], (p = < .001), and were 2.49 times as likely to report any difficulty going out as older people reporting a stroke only 95% CI [1.53, 4.01], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting emphysema correctly predicted 82.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 17.1% of the variance (Cox & Snell = .171, Wald $\chi^2 = 84.61$, p = < .001). Specific comparisons revealed older people reporting both conditions were 12.19 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [6.53, 22.72], (p = < .001), 3.98 times as likely to report difficulty going out than older people reporting vision impairment only 95% CI 1.90, 6.71], (p = < .001), and were 3.70 times as likely to report any difficulty going out as older people reporting emphysema only 95% CI [1.91, 6.71], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting asthma correctly predicted 82.1% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.8% of the variance (Cox & Snell = .168, Wald χ^2 = 73.80, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 6.37 times as likely as to report any difficulty going out than older people reporting neither comparison 95% CI [4.13, 9.80], (*p* = < .001), 1.86 times as likely to report any difficulty going out than older people reporting vision impairment only, 95% CI [1.18, 2.92], (*p* = <.01), and were 3.40 times as likely to report any difficulty going out as older people with asthma only 95% CI [2.11, 5.46], (*p* = < .001).

The results of the full regression model comparing vision impairment and older people reporting cancer correctly predicted 82.2% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 16.3% of the variance (Cox & Snell = .163, Wald χ^2 = 67.41, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 4.23 times as likely to report any difficulty going out than older people reporting neither condition 95% CI [3.07, 5.81], (*p* = < .001), 1.25 times as likely, but were not statistically significantly more likely, to report difficulty going out than older people reporting vision impairment only 95% CI [.88, 1.771], (*p* = 0.220), and were 3.87 times as likely to report any difficulty going out as older people reporting cancer only 95% CI [2.79, 5.34], (*p* = < .001).

The results of the full regression model comparing vision impairment and older people reporting diabetes correctly predicted 82.2% of the outcome variables, indicated the predictors, as a group, statistically significantly contributed to the model, and explained 17.9% of the variance (Cox & Snell = .179, Wald χ^2 = 87.06, *p* = < .001). Specific comparisons revealed older people reporting both conditions were 8.26 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [2.04, 5.05], (p = < .001), 2.46 times as likely to report any difficulty going out as older people reporting vision impairment only 95% CI [2.04, 5.05], (p = < .001), and were 3.33 times as likely to report any difficulty going out as older people reporting diabetes only 95% CI [2.04, 5.05], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting arthritis correctly predicted 82.4% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 19.1% of the variance (Cox & Snell = .191, Wald χ^2 = 121.248, p = < .001). Specific comparisons revealed older people reporting both conditions were 9.17 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI 7.19, 11.63], (p = < .001), 2.59 times as likely to report any difficulty going out than older people reporting vision impairment only 95% CI [1.85, 3.61], (p = < .001), and were 3.02 times as likely to report any difficulty going out as older people reporting arthritis only 95% CI [2.42, 3.77], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting depression correctly predicted 82.3% of the outcome variables, indicated the variables, as a group, statistically significantly contributed to the model, and explained 17.5% of the variance (Cox & Snell = .175, Wald χ^2 = 86.18, p = < .001). Specific comparisons revealed older people reporting both conditions were 6.21 times as likely to report any difficulty going out than older people reporting neither condition 95% CI [4.73, 8.13], (p = < .001), 1.75 times as likely to report any difficulty going out than older people reporting vision impairment only 95% CI [1.24, 2.47], (p =<.01), and were

2.69 times as likely to report any difficulty going out than older people reporting depression only 95% CI [2.02, 3.57], (p = < .001).

The results of the full regression model comparing vision impairment and older people reporting trouble hearing correctly predicted 81.9% of the outcome variables, indicated the predictors, as a group, statistically significantly contributed to the model, and explained 17.0% of the variance (Cox & Snell = .170, Wald χ^2 = 81.25, p = < .001). Specific comparisons revealed older people reporting both conditions were 5.74 times as likely as to report any difficulty going out than older people reporting neither condition 95% CI [4.46, 7.35], (p = < .001), 1.76 times as likely to report any difficulty going out than older people reporting vision impairment only 95% CI [1.31, 2.38], (p = < .001), and were 3.34 times as likely to report any difficulty going out than older people reporting trouble hearing only 95% CI [2.50, 4.46], (p = < .001).

Examination of Research Question 5

Research question five asked: *How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55?* The hypothesis for research question five stated: *There is an observed linear relationship between age and experiencing mobility or vision activity limitations, or participation restriction among older people with no vision impairment or selected comorbid condition, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.* In examining research question five, four logistic regression procedures were used to examine how the probability of experiencing mobility and participation restrictions change for older people with no vision impairment or comorbid condition, vision impairment alone, comorbid condition alone, and vision impairment coupled with a health condition as people age beyond age 55. In order to examine this research question, the odds ratios for age were reviewed across all regression models conducted in this study. This review revealed that vision impairment coupled with depression resulted in the largest odds ratio for age across each of the four dependent variables examined in this study.

Four new logistic regression models were conducted for vision impairment and depression by each of the dependent variables, controlling for all independent variables in the study and using the same comparison groups previously used. These regression models were conducted with the predicted probabilities saved to model the linearity of changes in predicted probabilities by any difficulty by condition group by age. Because four sets of predicted probabilities were generated, one for each dependent variable, a new variable was computed to reflect the average predicted probability an older person would experience any one of the mobility, visual acuity, or participatory limitations examined in this study. This average predicted probability value was graphed by condition group by age to examine whether a linear trend could be observed among the four vision/condition groups investigated in this study. A two-period moving average trend line was included to smooth any sharp change in predicted probability for any age category. These results are visually displayed in Figure 7 and suggest a linear relationship in the predicted probability of older adults with any of the condition categories examined in this study. However, the predicted probability values for each specific group reveal substantial differences. Older people reporting neither vision impairment nor depression revealed a predicted probability of experiencing either of the mobility or visual activity limitations, or participatory restriction ranged from approximately .13 to .40 between age 55 and 85, which is a top coded age in these data. These values ranged from .38 to .72 for older people reporting vision impairment only, .25 to .56 for older people reporting depression only, and .52 to .83 for older people reporting both conditions.

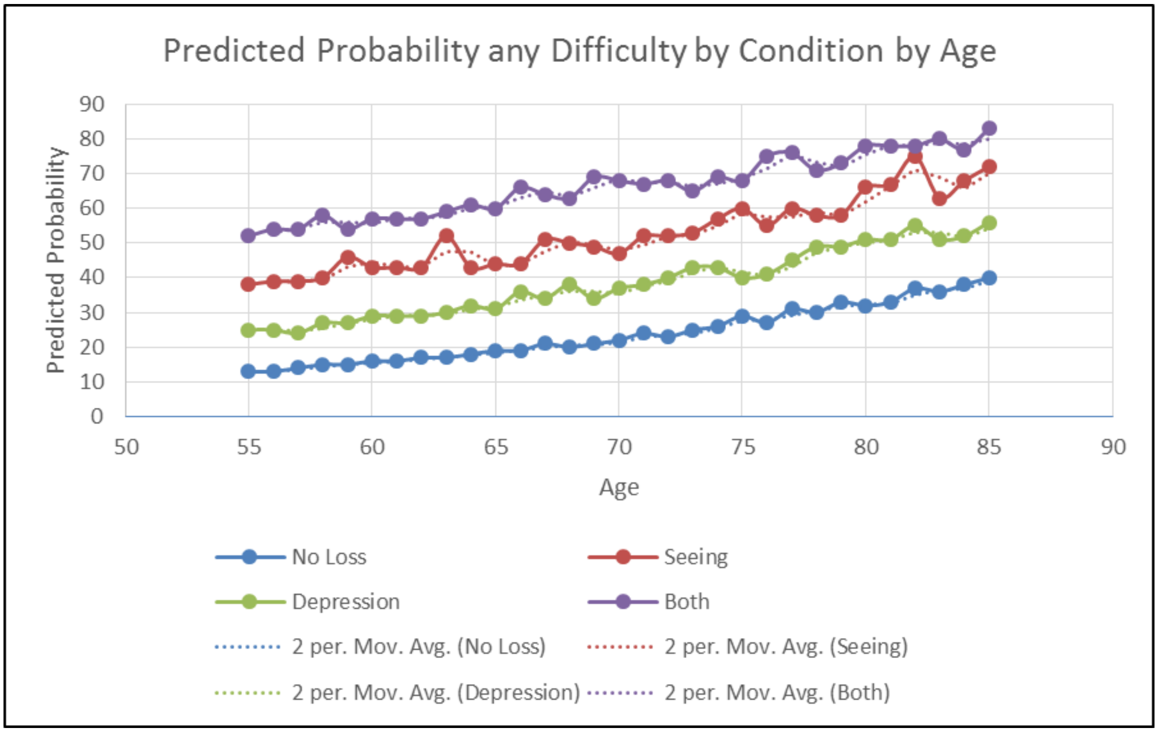

Figure 7. Predicted probability any difficulty by condition group by age.

Summary

Chapter five presented the results of the statistical analyses along with explainations of the data including necessary explanations of reporting and interpretative features unique to complex, multi-stage survey data. Each research question was examined and the results thoroughly reported. Detailed descriptions were revealed for all groups examined in this study. Research question one revealed the prevalence of eye diseases and comorbid conditions among older adults. Results of each logistic regression model is reported and reveals statistically significant results, which are discussed in chapter five. In addition, predicted probabilities are plotted to reveal the probabilities of experiencing any of the limitations or restrictions examined in this study.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter summarizes the purpose, findings, and the conclusions of this investigation as well as the study's limitations, implications, and recommendations for future research. The purpose of the study was to investigate the prevalence and effects of vision impairment in conjunction with other comorbid conditions. Consequently, in this study four groups were identified: (a) older people with neither vison impairment nor comorbid conditions, (b) older people with vision impairment only, (c) older people with chronic conditions only, and (d) older people with both vision impairment and comorbid conditions. This study utilized data from the 2008 National Health Interview Survey, the most recent nationally representative data that includes expanded vision, health conditions, and activity questions, to examine predictors of complications of vision impairment among older people (NCHS, 2009). In addition, selected demographic variables and geographic locations (region of residence) were used as control variables to investigate the variance accounted for in the full logistic regression models. This study used logistic regression techniques to compare the aforementioned four groups. These comparisons were made to determine whether older people with vision impairment and comorbid conditions were statistically significantly more likely to experience mobility or visual activity limitations, and participation restrictions than older people without vision impairment or comorbid conditions, vision impairment only, or comorbid conditions only.

These data were read into SPSS version 22 (IBM, 2013) with complex sample module and analyzed for missing values and outliers. Detailed frequency analyses were conducted of vision impairment and condition variables to determine national prevalence estimates of older people reporting vision impairment and specific vision conditions. In addition, demographic analyses were conducted for independent variables that were used as control variables in all full logistic regression models. These control variables included age, sex, race/ethnicity, marital status, region of residence, and health status. After frequency analyses were conducted among the control variables, race/ethnicity, region of residence, and marital status were recoded into dichotomous variables. Frequency analyses were conducted for each of the comorbid conditions examined in this study, and these variables were recoded into the four groups. Finally, frequency analyses were conducted for all limitation variables examined in the study. These frequency analyses revealed the most limiting mobility and vision activity limitations and participation restrictions, which were used as dependent variables in the study. These dependent variables were recoded into dichotomous variables indicating no difficulty reported and any difficult or inability to do the specific activities. The following five research questions and hypotheses guided the study:

1. What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations participation restrictions?

Hypothesis: There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.

2. What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.

3. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?

   Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

4. What is the likelihood that older people with no vision impairment or comorbid condition, vision impairment only, selected comorbid condition

only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?

Hypothesis: Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.

5. How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55.

   Hypothesis: There is an observed linear relationship between age and experiencing a mobility or vision activity limitation, or participation restriction among older people with no vision impairment or selected comorbid conditions, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.

Summary of Findings and Conclusions

The introduction, review of the literature, research design and methodology, and results for this study were presented in chapters one through four. Brief summaries of the chapters follow.

Chapter one included the statement of the problem, purpose of the study, definition of terms, research questions, research design and methodology summary, delimitation, and significance of the study. In addition, the conceptual and theoretical frameworks were presented. This study sought to increase the level of knowledge about the demographic and vision impairment characteristics of the U.S., and relationships between the synergistic impact of vision impairment and selected comorbid conditions, and mobility and vision activity limitations, and participation restrictions among older people. This study reveals that older people with self-reported vision impairment represent a very heterogeneous population, and there are consistently significant synergistic effects on mobility and vision activity limitations and participation restrictions when vision impairment and selected comorbid conditions occur together. For example, more than 60% of the estimated U.S. older adult population reported trouble seeing, hypertension, or vision impairment and hypertension. In addition, an estimated 21.7 million older people reported having had cataracts, and, of those, more than 12 million reported having had cataract surgery. Moreover, an estimated 61.8 million older people reported wearing glasses or contact lenses. With respect to the relationship between vision impairment and comorbid conditions, mobility and vision activity limitations, and participation restrictions, the presence of vision impairment and any of the comorbid conditions included in this study revealed a statistically significant greater likelihood of any difficulty in performing any of the activities examined. These findings suggest that a very large population of people with vision impairment experience substantial functional and social limitations that are exacerbated by the presence of comorbid conditions.

Chapter two provided a review of the literature. The research questions, theoretical and conceptual frameworks, recent refinements in the *ICF* (World Health Organization, 2002), vision and health components of Healthy People 2020 (Healthy

People 2020, 2010), and advocacy for expanded surveillance systems guided the literature review. Detailed attention was given to a review of the historical account of fears associated with vision impairment and the paradigm shift in conceptualization of ADLs and IADLs toward the framework provided by the *ICF* (World Health Organization, 2002). Notable prior research in these areas includes Verbrugge, Lepkowski, and Imanaka (1989), who examined multiple chronic conditions and concluded arthritis and high blood pressure were the two most prevalent comorbid conditions in older people. In addition, these researchers identified chronic conditions, which are included in the present study. Fried et al. (1999) found a synergetic effect of vision impairment and chronic conditions, but did not examine predictors of difficulty. Nevertheless, these findings were a critical foundation to expand these findings in the present study.

Other researchers noted similar findings. Specifically, Anderson and Horvath (2004) noted there were 125 million Americans (45% of the population) reporting chronic conditions and 61 million (21%) reported multiple conditions. These findings demonstrated the need to frame vision loss as a public health concern. Therefore, considerable attention was given to recent efforts to frame vision impairment as a public health concern. Crews, Jones, and Kim (2009) applied findings about chronic conditions and vision impairment as public health concerns and observed reading was a substantial complication from vision impairment. Moreover, Capella-McDonnall (2005) found that depression was a significant complication of vision impairment. Finally, the review of the literature included recent reports of the growing need to increase understandings of vision impairment coupled with other health conditions, thus clarifying six factors and a theoretical approach that guided this study.

Chapter three presented the research design and methodology. This study included a detailed analysis of the demographic, and comorbid and vision condition characteristics of the older adult population in the U.S. In addition, this study utilized a complex array of logistic regression models to examine five specific research questions and their accompanying hypotheses. This chapter also included a description of the variables, data collection, and the analytic procedures, including the unique statistical procedures necessary when using complex, multi-stage survey data.

Chapter four presented the results of the statistical analysis along with a discussion of the unique statistical interpretations and reporting necessary when using complex, multi-stage survey data. For research question one, descriptive statistics were used to provide detailed profiles of the demographic, vision condition, comorbid condition, and mobility and vision activity limitations, and participation restrictions in the U.S. For research questions two, three, and four logistic regression procedures were employed to analyze the data, and summary findings were reported. For research question five, four logistic regression models were used to aggregate and visually display the predicted probabilities of the vision impairment and comorbid conditions revealing the largest odds ratio for age.

The following provides a summary of the findings and conclusions for each research question in this study. Research question one asked: *What are the national demographic characteristics of older people, including prevalence of self-reported vision impairment, specific eye diseases, selected health conditions, and activity limitations* *participation restrictions?* The results revealed that the older adult population is quite diverse in the U.S. Of the estimated 70.7 million older people, the majority are female, married, live in the South or Midwest, are white (non-Hispanic), consider their health about the same as it was in the past twelve months, and average 67.1 years of age. An estimated 11.3 million reported trouble seeing. However, an estimated 29.5 million older people reported one of the vision conditions (macular degeneration, diabetic retinopathy, glaucoma, and cataracts) reported in the data, and, of those, almost 8.4 million reported losing vision because of the reported conditions. These results support the importance of self-report measures of vision impairment. Finally, more than 55 million older people reported wearing glasses or contact lenses, and 40 million use their corrective lenses to drive, read signs, or watch TV. Surprisingly, only 3.3 million reported using adaptive devices, and only 430,000 reported using rehabilitation services, which is consistent with earlier findings (Ryskulova et al., 2008). As many as 43% of older people reported difficulty performing mobility activities, 20% reported difficulty performing vision activity activities, and as many as 20% reported difficulty performing social activities. Finally, as many as 62% of older adults reported vision impairment or comorbid conditions, and the smallest vision/health condition combinations indicated just under 20% of older people reported vision impairment and/or emphysema. This research question tested the following hypothesis: *There are no statistically significant differences in the regional prevalence rates of vision impairment, when controlling for selected independent variables.* These results indicated that there was no statistically significant relationship between vision impairment and region of resident. These findings suggest that older people's region of residence has no relationship to the likelihood of reporting vision impairment.

Research question two asked the following: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced mobility limitations?* This research question examined the effect of vision impairment, and selected comorbid and health conditions on the likelihood of experiencing mobility limitations among older adults. Specifically, older people reporting vision impairment and one of eleven selected comorbid conditions were compared with older people reporting neither condition nor either vision impairment or one of the health conditions to determine the likelihood of reporting difficulty stooping, bending, or kneeling, or walking ¼ mile.

These models consistently revealed people reporting vision impairment and one of the comorbid conditions were statistically significantly more likely to report any difficulty performing either of the mobility tasks than any of the three groups. These results revealed that people reporting vision impairment and any of the selected comorbid or health conditions were, reported as odds ratios, at least 3.95 (cancer) times as likely and as much as 11.36 (emphysema) times as likely to report any difficulty stooping, bending, or kneeling than people reporting neither condition. This range in values suggest the synergistic effects of vision impairment in combination with other conditions. However, these models also allowed inferences about the contributions of vision impairment or one of the comorbid conditions to the likelihood of reporting any difficulties.

Specific observations indicate when comparing older people with vision impairment and comorbid conditions with older people reporting vision impairment only and older people reporting comorbid conditions only, vision is the larger contributor, reported as odds ratios, when co-existing with hypertension (3.07 vs. 2.24), coronary heart disease (3.31 vs. 2.19), heart condition (2.79 vs. 1.79), stroke (3.16 vs. 2.76), emphysema (4.92 vs. 3.83), asthma (3.85 vs. 2.59), cancer–was not a statistically significant contributor (3.36 vs. 1.32), diabetes (2.64 vs. 2.40), depression (2.36 vs. 1.75), and hearing (2.80 vs. 1.78). Only arthritis was a greater contributor to reporting any difficulty stooping, bending, or kneeling (3.73 vs. 2.79).

Because walking is a fundamental activity, older people reporting difficulty walking ¼ mile was also examined as a dependent variable to investigate the relationship between older people reporting vision impairment and one of eleven selected health conditions. Older people reporting both conditions were compared with older people reporting neither condition, vision impairment only, or comorbid conditions only reporting any difficulty walking ¼ mile. These results revealed that older people reporting vision impairment and any of the selected comorbid conditions, reported as odds ratios, were at least 3.16 (cancer) times as likely and as much as 9.01 (coronary heart disease) times as likely to report any difficulty walking ¼ mile. This range of values suggests the synergistic effects of vision impairment and any of the comorbid conditions. However, these models also allowed inferences about the contribution of vision impairment and one of the health conditions to the likelihood of reporting any difficulty walking ¼ of a mile.

Specific observations indicate when comparing older people with vision impairment and comorbid conditions with older people reporting vision impairment only or comorbid conditions only, vision is the larger contributor, reported as odds ratios, when co-existing with hypertension (2.80 vs. 2.25), heart condition (3.05 vs. 1.60), asthma (2.88 vs. 1.34), cancer–was not a statically significant contributor (3.36 vs. 1.32), depression (2.34 vs. 1.53), and hearing impairment (2.35 vs. 1.18); however, older people reporting trouble seeing and hearing loss were not statistically significantly more likely than older people reporting vision impairment only to report any difficulty reading. When examining the likelihood of reporting any difficulty walking ¼ mile, several health conditions contributed more to the synergistic effects of the vision impairment coupled with selected comorbid conditions. These conditions included arthritis (3.18 vs. 2.62), coronary heart disease (3.34 vs. 3.05), stroke (2.80 vs. 1.82)–though not statistically significantly more likely than older people reporting stroke alone, emphysema (2.82 vs. 1.79)–though not statistically significantly more likely than older people reporting emphysema alone, and diabetes (2.63 vs. 2.68).

This research question considered the following hypothesis: *Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience mobility limitations than older people with vision impairment only, older people with chronic conditions only, or older people without vision impairment or chronic conditions.* The results revealed consistent statistically significant models results in all twenty-two regression models examining mobility limitations. These results reveal statistically significant relationships between vision impairment co-existing with the comorbid conditions examined in this study. Therefore, there is a statistically significant effect of vision impairment and comorbid conditions on the likelihood of experiencing mobility limitations among older adults. In addition, these results reveal that vision impairment is a greater contributor in ten of the eleven models when examining stooping, bending, or knelling difficulties, and in six of the eleven models examining any difficult walking ¼ mile. These results suggest the importance of both the effect of older people having vision impairment and comorbid conditions, and the greater contribution of vision impairment in mobility limitations.

Research question three was the following: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced visual activity limitations?* This research question examined the effects of vision impairment and selected comorbid conditions on the likelihood of experiencing visual activity limitations among older adults. Specifically, older people reporting vision impairment and one of eleven selected comorbid or health conditions were compared with older people reporting neither condition, vision impairment only, and the comorbid conditions only to determine the likelihood of reporting any difficulty reading. These models consistently revealed people reporting vision impairment and one of the health conditions were more likely, reported as odds ratios, to report any difficulty reading than any of the three groups. These results revealed that people reporting vision impairment and any of the selected comorbid conditions were at least 5.13 (hearing) times as likely and as much as 15.9 times as likely to report any difficulty reading. This range in values suggests the synergistic effect of vision impairment and any of the comorbid conditions. However, these models also allowed inferences about the contribution of vision impairment or one of the comorbid conditions to the presence of difficulty.

Specific observations indicate vision impairment is the larger contributor when co-existing with any of the conditions examined in this study. These results reveal the following odds ratio differences indicating vision impairment is the largest contributor, reported as odds ratios, when comorbid with hypertension (9.09 vs. 1.30), coronary heart disease (8.33 vs. 1.18), heart condition (8.62 vs. 1.04), stroke (8.20 vs. 1.56), emphysema (11.36 vs. 1.96), asthma (9.62 vs. 1.24), cancer (9.99 vs. 1.17), diabetes (11.37 vs. 1.44), arthritis (7.99 vs. 1.09), depression (6.58 vs. 1.32), and hearing (7.69 vs. 1.42). Moreover, these results revealed that hypertension, coronary heart disease, heart conditions, asthma, cancer, and arthritis were not statistically significant contributors to reporting any difficulty in reading.

This research question considered the following hypothesis: *Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience visual activity limitations than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.* The results revealed consistent statistically significant models results in all 11 regression models examining vision activity limitations. These results reveal statistically significant relationships between vision impairment co-existing with the comorbid conditions examined in this study. Therefore, there is a statistically significant effect of vision impairment and comorbid conditions on the likelihood of experiencing vision activity limitations among older adults. In addition, these results reveal that vision impairment is a greater contributor in all eleven models when examining any difficulty reading. These results suggest the importance of both the effect of older people having vision impairment and comorbid conditions, and the greater contribution of vision impairment in mobility limitations.

Research question four asked the following: *What is the likelihood that older people with no vision impairment or comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with comorbid conditions, have experienced participation restrictions?* This research question examined the effect of vision impairment, and selected comorbid conditions on the likelihood of experiencing participation restrictions among older adults. Specifically, older people reporting vision impairment and one of eleven selected comorbid or health conditions were compared with older people reporting neither condition, vision impairment only, and the comorbid conditions only to determine the likelihood of reporting any difficulty going out. These models consistently revealed people reporting trouble seeing and any one of the comorbid conditions were, reported as odds ratios, more likely to report any difficulty going out. These results revealed that people reporting vision impairment and any of the selected comorbid or health conditions were at least 4.25 (cancer) times as likely and as much as 10.31 (stroke) times as likely to report any difficulty going out than people reporting neither condition. This range in values suggests the synergistic effects of vision impairment and any of the comorbid conditions. However, these models also allowed inferences about the contribution of vision impairment or one of the health conditions to the likelihood of reporting any difficulty.

Specific observations indicate when comparing older people with vision impairment and comorbid conditions with older people reporting vision impairment only and older people reporting comorbid conditions only, vision is the larger contributor, reported as odds ratios, when co-occurring with hypertension (3.39 vs. 1.56), coronary heart disease (3.22 vs. 2.50), heart condition (2.72 vs. 1.55), emphysema (3.70 vs. 3.58), asthma (3.40 vs. 1.86), cancer–was not a statically significant contributor (3.87 vs. 1.25), diabetes (3.33 vs. 2.46), arthritis (3.02 vs. 2.59), depression (2.69 vs. 1.75), and hearing (3.34 vs. 2.69). Only stroke was a greater contributor than vision impairment to the likelihood of reporting any difficulty going out (2.94 vs. 2.49).

This research question considered the following hypothesis: *Older people with vision impairment and comorbid conditions are, even when controlling for other variables, statistically significantly more likely to experience participation restrictions than older people with vision impairment only, older people with comorbid conditions only, or older people without vision impairment or comorbid conditions.* The results revealed consistent statistically significant models results in all eleven regression models examining participation restrictions. These results reveal statistically significant relationships between vision impairment co-existing with the comorbid conditions examined in this study. Therefore, there is a statistically significant effect of vision impairment and comorbid conditions on the likelihood of experiencing participation restrictions among older adults. In addition, these results reveal that vision impairment is a greater contributor in ten of the eleven models when examining any difficulty going out. These results suggest the importance of both the effect of older people having vision impairment and comorbid conditions, and the greater contribution of vision impairment in participation restrictions.

Research question five asked the following: *How does the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or selected comorbid conditions, vision impairment only, selected comorbid conditions only, and vision impairment coupled with selected comorbid conditions change as they age beyond age 55?* In examining this research question, four logistic regression procedures were used to examine how the probability of experiencing mobility and vision activity limitations, and participation restrictions change for older people with no vision impairment or comorbid conditions, vision impairment alone, health conditions alone, and vision impairment coupled with comorbid conditions as people age beyond age 55. After reviewing the odds ratios for age, depression was found to have the greatest effect on age. Predicted probabilities were saved from these regression models and combined into a new variable to reflect the average probability of experiencing any of the limitations reviewed in this study.

This average predicted probability value was graphed by condition group by age to examine whether linear trends could be observed among the four vision/condition groups investigated in this study. A two-period moving average trend line was included to smooth any sharp change in predicted probability for any age category. These predicted probability values for each specific group reveal substantial differences. Older people reporting neither vision impairment nor depression revealed predicted probabilities of experiencing either of the mobility or vision activity limitations, or participation restriction ranged from approximately .13 to .40 between age 55 and 85 (the top coded age in these data). These values ranged from .38 to .72 for older people reporting vision impairment only, .25 to .56 for older people reporting depression only, and .52 to .83 for older people reporting both conditions. These findings suggest that older people reporting neither vision impairment nor depression have a 40% chance of reporting any difficulty in either of these limitations or restrictions by age 85 and people reporting both vision impairment and depression have an 83% chance of reporting any difficulty in either of these limitations or restrictions.

This research question considered the following hypothesis: *There is an observed linear relationship between age and experiencing a mobility or vision activity limitation, or participation restriction among older people with no vision impairment or selected comorbid conditions, vision impairment only, comorbid conditions only, and vision impairment coupled with selected comorbid conditions.* While the results of this research question are largely subjective, the trends are clearly observable. As reflected by the increasing predicted probability values, the terns suggest a strong linear relationship of the likelihood of experiencing any of the selected limitations or restrictions examined in this study. Moreover, these results suggest few older people who experience vision impairment and comorbid conditions can avoid substantial mobility or vision activity limitations, or participation restrictions.

Limitations of the Study

The delimitations of the study posed certain restrictions. This study was bound to the scope of variables included in the original data; therefore, several analytical approaches were limited because of the structure of the sample. For example, the complex, multi-stage sample data limited the ability of the researcher to create a summary measure of mobility, visual activity, or participation difficulties. While the mobility and vision activity limitation and participation restriction variables were measured on a Likert type scale, the values were not coded in a manner that could yield a continuous summary variable that measured a progressive degree of difficulty. It simply asked respondents to reply to a degree of difficulty or inability to perform an activity. This inability restricted analyses to logistic regression procedures, thus preventing multiple regression models. Multiple regression models would allow analyses to be conducted to examine how mobility or vision activity limitations and/or participation restrictions incrementally change (i.e. higher scores on a summary measure) as people age with vision impairment and comorbid conditions. A second imitation was the self-report nature of the identification of comorbid conditions. The variables were all determined by older adults, or a proxy, being asked if they had ever been told by a doctor they had one of the conditions of interest. While the results of these analyses revealed clear mobility and vision activity limitations and participatory restrictions, it would have been ideal to have clinical measures to cross-validate the outcome measures. Another limitation was the selection of only four limitation or participation variables being used to investigate the research questions in the study. Ideally, all of the mobility and vision activity limitation and participation restriction measure could have been analyzed to provide a more complete understanding of the effects of vision impairment and comorbid conditions. A final limitation included the limited ability, given the available questions, to include measures that could connect mobility, vision, and participation activities. For example, there were no variables that could access potential connections between mobility, vision activities, and social participation. In addition, this study was limited to the comorbid conditions included in the original survey. Goodman et al. (2013) identified twenty comorbid conditions that should frame these types of investigations and only ten were included in this study.

Implications and Recommendations for Future Research

This study revealed that older adults comprise a very diverse population. In addition, the results suggest that older people reporting vision impairment and any of the comorbid conditions examined in this study experience synergistic effects on the self-reported mobility and visual activity limitation, and participation restriction measures. Moreover, vision impairment was the largest contributor to these difficulties in a majority of the vision impairment and chronic condition combinations, and the findings indicate a visible linear trend in the probability of experiencing any of the mobility and vision activity limitations, or participation restrictions examined in the study. Given the collective nature of these findings, the study's results suggest multiple implications for practitioners, researchers, and policy makers, which are highlighted in the following.

Implications for Practitioners

The findings from this study reveal multiple implications for practitioners. Given the aforementioned diverse nature of the U.S. older adult population, practitioners can use these findings to narrow their foci toward older people with vision impairment when they have comorbid conditions. These findings highlight the need to individualize case management decisions. In addition, practitioner can use this information to tailor independent living rehabilitation plans to consider whether vision impairment or comorbid conditions are the primary contributor to difficulties in performing ADLs or IADLs. These findings suggest the following specific implications for practitioners when providing services to older people.

1. Individualize treatment plans should be developed according to the existence of vision impairment of comorbid conditions alone, or whether older people have vision impairment and a comorbid condition.
2. Practitioners should consider the nature of limitation of restriction older people are experiencing.
3. Treatment plans should be formulated according to the complete nature of mobility or vision activity limitations, or social participation restriction
4. Practitioners should consider the relationship between mobility and activity limitations, and social participation in designing treatment plans for older adults.
5. Practitioners should consider the linear nature of mobility and vision activity limitations, and social participation restrictions as people age.
6. These findings can inform public health and clinical care as clinicians parse out vision problems from other comorbid problems and address them sequentially, separately, or at the same time to achieve better outcomes.

Implications for Researchers

Given the aforementioned large effects of vision impairment coupled with comorbid conditions, the results from this study suggest multiple implications for future research. Future researchers should incorporate these findings in future studies to more accurately document the entire scope of mobility and vision activity limitations, and participation restrictions among older people; therefore, the following recommendations should guide future research:

1. These findings should strengthen methodological approaches to clarifying case definitions for rehabilitation providers.
2. Future researchers should further explore the effect of clinically diagnosed comorbid conditions and vision conditions.
3. Future researchers should identify specific causes of vision impairment and comorbid conditions and investigate their effects on mobility and vision activity limitations, and participation restrictions.
4. Future researchers could create summary measures for mobility and vision activity limitations, and participation restrictions that could be used to create an index of difficulty to assess older people on their likelihood of having difficulty performing ADL and IADL tasks.
5. Future research should be directed to increased attention to the value of self-reported vision impairment to document the limitations and restrictions that are perceived by the person.
6. Future research should be directed toward the linkages of vision impairment and other measures of limitations and restrictions
7. These findings should guide future research examining the linkage between mobility and vision activity limitations, and participation limitations.

Implications for Policy Makers/Administrators

Given the aforementioned diverse nature of the population of older people in the U.S., and the large effects of vision impairment coupled with comorbid conditions, the results from this study suggest multiple implications and recommendations for policy makers and program administrators. One implication is that self-reported condition and limitation measures in nationally representative data can provide valuable documentation of the scope and effect of vision impairment. In addition, these data can inform public health officials about the limitations among older populations. Another implication is that a better system of identifying specific conditions that may accompany vision impairment is needed to quantify individualized treatment plans for older people. The CDC has recently strongly advocated for developing a national surveillance system to monitor vision impairment and its health consequences (CDC, 2010). In addition, vision impairment is increasingly being framed as a public health concern (CDC, 2010). Therefore, these findings illustrate the value of these data as national efforts continue toward this national surveillance system, which can be designed to monitor ongoing consequences of disability and comorbid conditions. Policy makers and program administrators can use the findings in this study to implement the following recommendations:

1. These findings can inform public health program planners and administrators care they develop programs and services that require vision impairment to be parsed out from comorbid conditions to achieve better independent living outcomes.

2. These findings could inform initiatives to expand coverage of vision health in new health care programs, which is largely omitted in the Affordable Health Care Act (Gustin, 2013).
3. These findings should guide policy planners and administrators as they develop new systems for data collection and surveillance.
4. These findings should guide program planners and rehabilitation professionals in developing strategies to deal with older adults when they are performing mobility activities.
5. These findings should guide program planners and rehabilitation professionals in developing strategies to connect mobility and vision activities limitations to participatory restrictions. In other words, an older person may not participate in social activities because of a mobility limitation.
6. These findings should guide program planners and rehabilitation professionals in developing strategies to reach the vast underserved numbers of older adults who apparently do not obtain rehabilitative services.

Summary

Chapter five summarized the research study and provided conclusions. Each of the five research questions was examined in detail. The overall findings of the study indicate that older people reporting vision impairment and comorbid conditions experience significant likelihood of having measurable difficulties performing mobility, visual acuity, or participation activities. Moreover, vision impairment was the most common contributor to these tendencies to experience difficulties in performing these activities. Three findings from this study are especially relevant. First, as Crews et al. (2006) found, reading is a substantial consequence of vision impairment. The regression models conducted in this study examining the effect of vision impairment and comorbid conditions on difficulty reading consistently revealed the largest effects as measured by odds ratios. Because reading is such a fundamental activity of independence, these findings highlight the effect of vision impairment, especially coupled with comorbid conditions on vision activity limitations. Second, Capella-McDonnall (2005) found that depression is a significant complication from vision impairment. In the present study, depression had the greatest effect on the probability of experiencing any of the mobility or vision activity limitation, or participation restriction examined in the study. These findings highlight the need to address depression as a comorbid condition among older people. Third, these findings consistently revealed that vision impairment co-existing with comorbid conditions are significant life events; thus, supporting the theoretical approach in this study. Therefore, future research should particularly focus on documenting the connection between mobility and activity limitations, and participation restrictions to clarify the role limitations play in social participation. These findings are significant as vision impairment is increasingly being framed as a public health concern. The present study's findings were compared to other research studies, and the limitations of the study and recommendations for policy and practice, and future research were presented. These findings can be used to inform future research, rehabilitation programs, public health initiatives, and expansion of health care options.

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APPENDIX A

DETAILED VARIABLE LIST

Table A1

Variables as in original data

Variable Type	Variable	Description
Sampling Variables		
	RECTYPE	Type of File
	HHX	HouseHold Indentifier
	WTFA_SA	Weight - Final Annual
	STRAT_P	Pseudo-stratum for public use file variance estimation
	PSU_P	Pseudo-PSU for public use file variance estimation
Demographic Variables		
	REGION	Region of Country - North, South, East, West
	SEX	Sex - Male/Female
	HISPANIC	Hispanic - recoded to Hispanic or NOT Hispanic
	RACE	Recoded White, Black, Hispanic, Other
	AGE	Age in years
	M_STATUS	Married, Never Married, Widowed, Divorced, Other
	AHSTATYR	Health better/worse/ same, compared w/12 months ago
Comorbid Condition		
	HYPEV	Ever been told you have hypertension
	CHDEV	Ever been told you had coronary heart disease
	HRTEV	Ever been told you had a heart condition/disease
	STREV	Ever been told you had a stroke
	EPHEV	Ever been told you had emphysema
	AASMEV	Ever been told you had asthma
	CANEV	Ever told by a doctor you had cancer
	DIBEV	Ever been told that you have diabetes
	ARTH1	Ever been told you had arthritis
	DEPRESS	Ever had depression
	HRAIDEV	Ever used a hearing aid if not now using
Vision Loss/Condition		
	AVISION	Trouble seeing even w/glasses/lenses
	ABLIND	Blind or unable to see at all
	VIM_DREV	EVER been told you had diabetic retionpathy
	VIMLS_DR	Lost vision because of diabetic retinopathy
	VIM_CAEV	EVER been told you had cataracts
	VIMLS_CA	"Lost vision because of cataracts"

Table A1 (Continued)

Variable Type	*Variable*	*Description*
	VIMCSURG	Ever had cataract surgery
	VIM_GLEV	EVER been told you had glaucoma
	VIMLS_GL	Lost vision because of glaucoma
	VIM_MDEV	EVER been you had macular degeneration
	VIMLS_MD	Lost vision because of macular degeneration
Vision Acuity Measures		
	VIMREAD	Wear eye glasses or contact lenses to read/write/cook/sew
	VIMDRIVE	Wear eyeglasses or contact lenses to drive/read/signs/watch TV
	VIMDRIVE	Currently wear eyeglasses or contact lenses?
Visual Activity Measures		
	AVDF_NWS	Even when wearing glasses difficult for you to read newspapers
	AVDF_CLS	Even when wearing glasses difficult for you to see up close/cook/sew
	AVDF_NIT	Even when wearing glasses difficult for you to go down stairs in dim light
	AVDF_DRV	Even when wearing glasses difficult for you todrive during daytime
	AVDF_PER	Even when wearing glasses difficult for you to notice objects while walking
	AVDF_CRD	Even when wearing glasses difficult for you to find something on crowded shelf
Assistive Devices		
	AVISREH	Use any vision rehabilitation services
	AVISDEV	Use any adaptiove devices such as magnifiers, talking materials
Mobility Limitations		
	FLWALK	How difficult to walk 1/4 mile w/o special equipment
	FLCLIMB	How difficult to climb 10 steps w/o special equipment
	FLSTAND	How difficult to stand 2 hours w/o special equipment
	FLSIT	How difficult to sit 2 hours w/o special equipment
	FLSTOOP	How difficult to stoop, bend or kneel w/o special equipment
	FLREACH	How difficult to reach over head w/o special equipment
	FLGRASP	How difficult to grasp small objects w/o special equipment

Table A1 (Continued)

Variable Type	*Variable*	*Description*
	FLCARRY	How difficult to lift/carry 10 lbs w/o special equipment
	FLPUSH	How difficult to push large objects w/o special equipment
Participatory Restrictions		
	FLSHOP	How difficult to go out to events w/o special equipment
	FLSOCL	How difficult to participate in social activities w/o sp eq
	FLRELAX	How difficult to relax at home w/o special equipment

Note. Original variable names and descriptions in original data

APPENDIX B

IRB APPROVAL

Study 14-394: A Study of the Relationships Between Activity Limitation and Participation Restrictions Among Older Adults with Vision Loss and Comorbid Conditions

nmorse@orc.msstate.edu <nmorse@orc.msstate.edu> Wed, Nov 26, 2014 at 8:59 AM
To: wks3@msstate.edu
Cc: nmorse@orc.msstate.edu, cpalmer@colled.msstate.edu

November 26, 2014

William Sansing
Counseling and Educational Psychology
Mailstop 9727
Mississippi State, MS

RE: HRPP Study #14-394: A Study of the Relationships Between Activity Limitation and Participation Restrictions Among Older Adults with Vision Loss and Comorbid Conditions

Dear Mr. Sansing:

The review of your study referenced above has been completed. While we sincerely appreciate the submission of your study, it was determined from the review that it does not meet the regulatory definitions for human subjects research. Therefore, HRPP approval is not required as the study is currently designed.

The regulatory definition of human subject is listed below:

45 CFR 46.102(f) Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains:
(1) Data through intervention or interaction with the individual, or
(2) Identifiable! private information.

The HRPP understands that all of the information to be used for your study is publicly available. Because your study uses solely existing, publicly available information, the project does not meet the regulatory definition of human subject (i.e., you or not intervening or interacting with individuals, nor obtaining identifiable, private information).

If in the future your study is revised such that it meets this definition, it must be submitted for HRPP review and approval prior to the conduct of such human subjects research.

If you have questions or concerns, please contact nmorse@orc.msstate.edu or call 662-325-5220.

Sincerely,

Nicole Morse, CIP
IRB Compliance Administrator

cc: Charles Palmer (Advisor)

APPENDIX C

DEMOGRAPHIC, VISION IMPAIRMENT, AND COMORBID CHARACTERISTICS

Table C1

Mobility limitations: all older people

Mobility Limitation Variable Level of Difficulty	Population Estimate	UnWeighted	%	SE	CI LL	CI UL
Walk 1/4 Mile						
Not at All Difficult	45,501,079	4,816	64.9	0.7	63.5	66.3
Little Difficult	5,212,377	581	7.4	0.4	6.7	8.2
Somewhat Difficult	4,519,960	552	6.4	0.3	5.8	7.1
Very Difficult	3,904,892	439	5.6	0.3	5	6.2
Can't Do At All	7,497,690	867	10.7	0.5	9.8	11.7
Do Not Do This Activity	3,459,700	454	4.9	0.3	4.4	5.5
Climb 10 Steps W/O Equipment						
Not at All Difficult	50,871,356	5,373	72.6	0.6	71.3	73.8
Little Difficult	4,980,376	580	7.1	0.3	6.5	7.8
Somewhat Difficult	3,899,889	487	5.6	0.3	5	6.2
Very Difficult	3,371,119	413	4.8	0.3	4.3	5.4
Can't Do At All	4,704,597	558	6.7	0.3	6.1	7.4
Do Not Do This Activity	2,238,442	296	3.2	0.2	2.4	3.7
Stand 2 Hours W/O Equipment						
Not at All Difficult	43,401,201	4,585	62.0	0.7	60.6	63.4
Little Difficult	5,217,757	596	7.5	0.4	6.8	8.2
Somewhat Difficult	4,801,427	537	6.9	0.3	6.2	7.6
Very Difficult	4,254,736	487	6.1	0.3	5.5	6.7
Can't Do At All	8,997,162	1,069	12.9	0.5	11.9	13.8
Do Not Do This Activity	3,303,558	424	4.7	0.3	4.1	5.4
Sit 2 Hours W/O Equipment						
Not at All Difficult	58,886,280	6,367	84.0	0.5	83	85
Little Difficult	3,734,203	442	5.0	0.3	4.8	5.9
Somewhat Difficult	3,152,986	391	4.5	0.3	4	5.1
Very Difficult	2,064,090	232	2.9	0.2	2.5	3.5
Can't Do At All	1,464,335	182	2.1	0.2	1.8	2.5
Do Not Do This Activity	773,751	96	1.1	0.2	0.8	1.5
Stoop.Bend. Kneel W/O Equipment						
Not at All Difficult	40,093,862	4,279	57.2	0.3	55.8	58.6
Little Difficult	7,913,836	866	11.3	0.07	10.5	12.1
Somewhat Difficult	7,711,208	865	11.0	0.4	10.2	11.9
Very Difficult	6,622,305	769	9.5	0.4	8.7	10.3
Can't Do At All	6,249,270	744	8.9	0.4	8.2	9.7
Do Not Do This Activity	1,454,607	181	2.1	0.2	1.7	2.5

Table C1 (Continued)

Mobility Limitation Variable Level of Difficulty	Population Estimate	UnWeighted	%	SE	CI LL	CI UL
Reach Overhead W/) Equipment						
Not at All Difficult	58,654,723	6,353	83.7	0.5	82.6	84.8
Little Difficult	3,866,248	470	5.5	0.3	5	6.1
Somewhat Difficult	3,350,607	396	4.8	0.3	4.3	5.4
Very Difficult	2,032,655	239	2.9	0.2	2.5	3.4
Can't Do At All	1,500,705	172	2.1	0.2	1.8	2.6
Do Not Do This Activity	659,057	76	0.9	0.1	0.7	1.3
Grasp Small Objects W/O Special Equipment						
Not at All Difficult	58,592,136	6,408	83.6	0.5	82.6	84.6
Little Difficult	4,780,547	522	6.8	0.3	6.2	7.5
Somewhat Difficult	3,896,735	448	5.6	0.3	5	6.2
Very Difficult	1,705,901	205	2.4	0.2	2.1	2.9
Can't Do At All	713,419	81	1.0	0.1	0.8	1.4
Do Not Do This Activity	372,203	43	0.5	0.1	0.3	0.8
Life/Carry 10lbs W/O Equipment						
Not at All Difficult	54,810,096	5,823	78.2	0.6	77.1	79.3
Little Difficult	3,611,839	442	5.2	0.3	4.7	5.7
Somewhat Difficult	3,236,736	377	4.6	0.3	4.1	5.2
Very Difficult	2,141,229	266	3.1	0.2	2.7	3.5
Can't Do At All	4,132,202	506	5.9	0.3	5.3	6.5
Do Not Do This Activity	2,136,177	293	3.0	0.2	2.6	3.5
Push Large Objects W/O Equipment						
Not at All Difficult	49,131,704	5,189	70.2	0.7	68.8	71.5
Little Difficult	4,300,600	499	6.1	0.3	5.6	6.8
Somewhat Difficult	3,422,995	397	4.9	0.3	4.3	5.5
Very Difficult	2,352,252	284	3.4	0.2	2.9	3.8
Can't Do At All	6,129,446	749	8.8	0.4	8.1	9.5
Do Not Do This Activity	4,682,568	584	6.7	0.4	6	7.5

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Table C2

Vision activity limitation: all older people

Vision activity Variable	**Population**	**UnWeighted**	**%**	**SE**	**CI**	
Level of Difficulty	**Estimate**				**LL**	**UL**
Read Newspaper						
Not at All	54,987,700	5,982	78.9	0.6	77.4	79.7
Little Difficult	7,763,254	879	11.1	0.5	10.2	12
Somewhat Difficult	3,893,317	452	5.6	0.3	5	6.2
Very Difficult	2,100,046	235	3.0	0.2	2.6	3.5
Can't Do Due to Eyesight	740,241	96	1.1	0.1	0.8	1.3
Do Not Do Other Reason	497,576	66	0.7	0.1	0.5	0.9
See Up Close/Cook/Sew						
Not at All	57,013,375	6,220	81.5	0.5	80.4	82.5
Little Difficult	6,091,888	699	8.7	0.4	8	9.5
Somewhat Difficult	3,608,233	412	5.2	0.3	4.6	5.7
Very Difficult	1,386,020	166	2.0	0.2	1.7	2.4
Can't Do Due to Eyesight	679,681	75	1.0	0.1	0.7	1.3
Do Not Do Other Reason	1,179,656	135	1.7	0.2	1.4	2.1
Go Down Stairs in Dim Light						
Not at All	59,246,149	6,432	84.7	0.5	83.7	85.7
Little Difficult	4,096,656	170	5.9	0.3	5.3	6.5
Somewhat Difficult	2,452,123	94	3.5	0.2	3.1	4
Very Difficult	1,670,664	45	2.4	0.2	2	2.8
Can't Do Due to Eyesight	411,928	83	0.6	0.1	0.4	0.8
Do Not Do Other Reason	2,052,715	885	2.9	0.2	2.5	3.5
Drive During Daytime						
Not at All	60,217,112	6,714	86.0	0.5	85.1	87
Little Difficult	1,374,662	1,013	2.0	0.2	1.6	2.4
Somewhat Difficult	748,812	94	1.1	0.1	0.9	1.3
Very Difficult	358,897	45	0.5	0.1	0.4	0.7
Can't Do Due to Eyesight	726,198	83	1.0	0.1	0.8	1.3
Do Not Do Other Reason	6,554,414	885	9.4	0.4	8.6	10.2
Notice Objects While Walking						
Not at All	63,911,024	6,936	91.5	0.3	90.8	92.2
Little Difficult	2,046,034	269	2.9	0.2	2.5	3.4
Somewhat Difficult	1,658,556	213	2.4	0.2	2	2.8
Very Difficult	813,201	106	1.2	0.1	0.9	1.4
Can't Do Due to Eyesight	381,701	37	0.5	0.1	0.4	0.8
Do Not Do Other Reason	1,007,761	125	1.4	0.2	1.2	1.8

Table C2 (Continued)

Vision activity Variable Level of Difficulty	Population Estimate	UnWeighted	%	SE	CI LL	CI UL
Find Something on Crowed Shelf						
Not at All	63,358,604	6,909	90.7	0.4	89.9	91.8
Little Difficult	2,866,757	349	4.1	0.3	3.6	4.7
Somewhat Difficult	1,824,122	228	2.6	0.2	2.2	3
Very Difficult	840,087	102	1.2	0.1	1	1.5
Can't Do Due to Eyesight	309,485	31	0.4	0.1	0.3	0.7
Do Not Do Other Reason	650,034	74	0.9	0.1	0.7	1.3

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Table C3

Participation restrictions: all older people

Variable / Level of Difficulty	Estimated N	UnWeighted N	%	SE	CI LL	CI UL
Go Out W/O Equipment						
Not at All	55,817,662	6,004	79.7	0.6	78.5	80.8
Little Difficult	3,518,531	432	5.0	0.3	4.5	5.6
Somewhat Difficult	3,524,253	408	5.0	0.3	4.5	5.6
Very Difficult	2,083,325	250	3.0	0.2	2.6	3.5
Can't Do At All	2,519,903	298	3.6	0.3	3.1	4.2
Do Not Do This Activity	2,601,295	315	3.7	0.3	3.2	4.3
Participate in Social Activities						
Not at All	58,010,400	6,260	82.8	0.5	81.8	83.8
Little Difficult	2,590,274	340	3.7	0.3	3.2	4.2
Somewhat Difficult	2,442,044	298	3.5	0.2	3	4
Very Difficult	1,657,635	200	2.4	0.2	2	2.8
Can't Do At All	2,241,473	256	3.2	0.3	2.7	3.8
Do Not Do This Activity	3,108,548	351	4.4	0.3	3.9	5.1
Relax at Home W/O Equipment						
Not at All	65,303,610	7,143	93.2	0.3	92.5	93.9
Little Difficult	2,096,412	258	3.0	0.2	2.6	3.5
Somewhat Difficult	1,296,159	153	1.9	0.2	1.5	2.2
Very Difficult	615,988	71	0.9	0.1	0.7	1.2
Can't Do At All	364,112	43	0.5	0.1	0.4	0.7
Do Not Do This Activity	368,665	37	0.5	0.1	0.3	0.9

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

Table C4

Vision impairment and comorbid condition prevalence

Variable	Condition	Estimate	UnWeighted	%	SE	CI LL	CI UL
Vision/Hypertension							
	No Loss or Condition	27,034,773	2,845	38.3	0.6	37	39.5
	Vision Loss Only	4,112,337	446	5.8	0.3	5.2	6.5
	Condition Only	32,280,132	3,663	45.7	0.6	44.5	47
	Both Loss and Condition	7,187,664	825	10.2	0.4	9.4	11
Vision/Coronary Disease							
	No Loss or Condition	53,169,213	5,857	75.4	0.6	74.2	76.5
	Vision Loss Only	9,498,305	1,079	13.5	0.4	12.6	14.4
	Condition Only	6,117,545	647	8.7	0.4	8	9.4
	Both Loss and Condition	1,764,146	189	2.5	0.2	2.1	3
Vision/Heart Disease							
	No Loss or Condition	50,981,986	4,585	72.2	0.6	70.9	73.4
	Vision Loss Only	8,761,717	596	12.4	0.4	11.6	13.3
	Condition Only	8,349,096	537	11.8	0.4	11	12.7
	Both Loss and Condition	2,536,682	487	3.6	0.3	3.1	4.2
Vision/Stroke							
	No Loss or Condition	55,817,774	6,106	79.1	0.5	78.1	80.1
	Vision Loss Only	9,851,666	1,097	14.0	0.5	13.1	14.9
	Condition Only	3,480,131	402	4.9	0.3	4.4	5.5
	Both Loss and Condition	1,406,825	171	2.0	0.2	1.7	2.4
Vision/Emphysema							
	No Loss or Condition	57,208,790	6,259	81.1	0.5	80	82
	Vision Loss Only	10,441,420	1,184	14.8	0.5	13.9	15.7
	Condition Only	2,106,105	249	3.0	0.2	2.6	3.5
	Both Loss and Condition	827,975	84	1.2	0.1	0.9	1.5
Vision/Asthma							
	No Loss or Condition	53,055,575	5,782	75.1	0.6	74	76.2
	Vision Loss Only	9,451,253	1,067	13.4	0.4	12.6	14.3
	Condition Only	6,268,309	727	8.9	0.4	8.2	9.6
	Both Loss and Condition	1,853,901	205	2.6	0.2	2.2	3.1
Vision/Diabetes							
	No Loss or Condition	48,821,946	5,304	70.5	0.6	69.3	71.7
	Vision Loss Only	8,349,395	926	12.1	0.4	11.3	12.9
	Condition Only	9,304,734	1,077	13.4	0.4	12.6	14.3
	Both Loss and Condition	2,737,593	317	4.0	0.2	3.5	4.5

Table C4 (Continued)

Variable	**Estimate**	**UnWeighted**	**%**	**SE**	**CI**	
Condition					**LL**	**UL**
Vision/Arthritis						
No Loss or Condition	34,305,452	3,710	48.6	0.7	47.2	50
Vision Loss Only	4,602,330	511	6.5	0.3	5.9	7.2
Condition Only	24,994,290	2,796	35.4	0.6	34.1	36.7
Both Loss and Condition	6,692,559	759	9.5	0.4	2.7	10.2
Vision/Cancer						
No Loss or Condition	48,939,943	5,401	69.3	0.6	70.5	68.0
Vision Loss Only	9,060,383	1,013	12.8	0.4	13.7	12.0
Condition Only	10,402,336	1,110	14.7	0.5	15.7	13.8
Both Loss and Condition	2,225,618	259	3.2	0.2	3.6	2.8
Vision/Depression						
No Loss or Condition	43,895,973	4,727	62.8	0.7	61.4	64.1
Vision Loss Only	6,121,989	669	8.8	0.4	8.1	9.5
Condition Only	14,841,417	1,713	21.2	0.6	20.1	22.3
Both Loss and Condition	5,089,887	591	7.3	0.3	6.6	8
Vision/Hearing Loss						
No Loss or Condition	43,701,878	4,876	61.8	0.7	60.6	63.1
Vision Loss Only	6,596,165	747	9.3	0.4	8.6	10.1
Condition Only	15,701,829	1,641	22.2	0.6	21.1	23.4
Both Loss and Condition	4,719,877	526	6.7	0.3	6.1	7.3

Note. CI = confidence interval; LL = lower limit; UL = upper limit; SE = Standard error
Data: NHIS: 2008. Subpopulation Age 55 and Above: Weighted = 70,719,749; Unweighted - 7,790

APPENDIX D

LOGISTIC REGRESSION SUMMARY TABLES

Table D1

Logistic regression: conditions by difficulty stooping, bending, or reaching

Variable	Odds Ratio [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Hyertension[a]						
No Loss	6.45 [5.15, 8.13]	.115	16.273	< .001	101.45	< .001
Vision Loss	2.24 [1.65, 3.03]	.153	5.270	< .001		
Hypertension	3.07 [2.47, 3.83]	.111	10.091	< .001		
Predicted Correct =68.0%						
Cox & Snell = 0.166 (0.089[b])						
Full Model						
Coronary Heart Disease[a]						
No Loss	6.49 [4.08, 10.31]	0.234	7.997	< .001	82.347	< .001
Vision Loss	2.19 [1.34, 3.57]	0.248	3.162	<.01		
Coronary Heart Disease[a]	3.31 [1.97, 5.52]	0.261	4.577	< .001		
Predicted Correct =68.0%						
Cox & Snell = 0.150 (0.065[b])						
Full Model						
Heart Condition						
No Loss	5.37 [3.71, 7.75]	0.188	8.951	< .001	87.268	< .001
Vision Loss	1.79 [1.17, 2.74]	0.216	2.699	<.01		
Heart Condition	2.79 [1.85, 4.17]	0.205	4.989	< .001		
Predicted Correct =68.1%						
Cox & Snell = 0.152 (0.068[b])						
Full Model						
Stroke[a]						
No Loss	8.13 [4.76, 13.89]	0.272	7.698	< .001	83.134	< .001
Vision Loss	2.76 [1.59, 4.78]	0.280	3.625	< .001		
Stroke	3.16 [1.75, 5.68]	0.299	3.848	< .001		
Predicted Correct =67.8%						
Cox & Snell = 0.151 (0.068[b])						
Full Model						
Emphysema[a]						
No Loss	11.36 [4.76, 27.03]	0.443	5.493	< .001	70.757	< .001
Vision Loss	3.83 [1.59, 9.26]	0.447	3.011	<.01		
Emphysema	4.92 [1.95, 12.50]	0.473	3.373	<.01		
Predicted Correct =67.8%						
Cox & Snell = 0.149 (0.060[b])						
Full Model						
Asthma[a]						
No Loss	7.520 [4.67, 12.05]	0.242	8.340	< .001	76.697	< .001
Vision Loss	2.590 [1.56, 4.31]	0.257	3.710	< .001		
Asthma	3.850 [2.33, 6.33]	0.254	5.294	< .001		
Predicted Correct =67.6%						
Cox & Snell = 0.152 (0.062[b])						

Table D1 (Continued)

Variable	Odds Ratio [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Asthma[a]						
No Loss	7.520 [4.67, 12.05]	0.242	8.340	< .001	76.697	< .001
Vision Loss	2.590 [1.56, 4.31]	0.257	3.710	< .001		
Asthma	3.850 [2.33, 6.33]	0.254	5.294	< .001		
Predicted Correct =67.6%						
Cox & Snell = 0.152 (0.062[b])						
Full Model						
Cancer[a]						
No Loss	3.950 [2.71, 5.75]	0.190	7.221	< .001	62.363	< .001
Vision Loss	1.320 [.86, 2.02]	0.215	1.307	0.192		
Cancer	3.360 [2.25, 5.05]	0.204	5.940	< .001		
Predicted Correct =67.5%						
Cox & Snell = 0.144 (0.054[b])						
Full Model						
Diabetes[a]						
No Loss	7.19 [5.00, 10.31]	0.184	10.692	< .001	108.815	< .001
Vision Loss	2.40 [1.59, 3.61]	0.208	4.199	< .001		
Diabetes	2.64 [1.81, 3.93]	0.197	4.996	< .001		
Predicted Correct =69.1%						
Cox & Snell = 0.167 (0.081[b])						
Full Model						
Arthritis[a]						
No Loss	10.87 [8.70, 13.70]	0.116	20.559	< .001	251.092	< .001
Vision Loss	3.72 [2.68, 5.18]	0.167	7.87	< .001		
Arthritis	2.67 [2.10, 3.37]	0.120	8.177	< .001		
Predicted Correct =71.0%						
Cox & Snell = 0.219 (0.160[b])						
Full Model						
Depression[a]						
No Loss	5.21 [3.97, 6.85]	0.138	11.921	< .001	94.860	< .001
Vision Loss	1.75 [1.21, 2.50]	0.183	3.043	<.01		
Depression	2.36 [1.79, 3.13]	0.143	6.032	< .001		
Predicted Correct =68.3%						
Cox & Snell = 0.162 (0.076[b])						
Full Model						
Hearing[a]						
No Loss	5.13 [4.00, 6.58]	0.126	12.962	< .001	88.265	< .001
Vision Loss	1.78 [1.30, 2.43]	0.159	3.639	< .001		
Hearing	2.80 [2.14, 3.67]	0.137	7.521	< .001		
Predicted Correct =78.9%						
Cox & Snell = 0.155 (0.071[b])						

Note. Controlling for Race/Ethnicity, Sex, Marital Status, Region, Health Status, and Age. Degrees of Freedom = 300. a = OR reverse computed for comparison of both conditions compared to all other groups. b = base model Cox & Snell. CI = confidence interval

Table D2

Logistic regression: conditions by walking ¼ mile

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Hyertension[a]						
No Loss	5.85 [4.71, 7.25]	.109	16.161	< .001	94.264	< .001
Vision Loss	2.25 [1.65, 3.08]	.159	5.119	< .001		
Hypertension	2.80 [2.27, 3.48]	.108	9.577	< .001		
Predicted Correct =73.1%						
Cox & Snell = 0.198 (0.085[b])						
Full Model						
Coronary Heart Disease[a]						
No Loss	9.01 [5.68, 14.29]	0.233	9.397	< .001	102.760	< .001
Vision Loss	3.34 [2.05, 5.43]	0.248	4.878	< .001		
Coronary Heart Disease[a]	3.05 [1.83, 5.10]	0.259	4.305	< .001		
Predicted Correct =73.3%						
Cox & Snell = 0.196 (0.074[b])						
Full Model						
Heart Condition						
No Loss	4.52 [3.30, 6.21]	0.161	9.380	< .001	74.004	< .001
Vision Loss	1.60 [1.12, 2.29]	0.181	2.604	<.05		
Heart Condition	2.33 [1.60, 3.36]	0.188	4.499	< .001		
Predicted Correct =72.9%						
Cox & Snell = 0.188 (0.64[b])						
Full Model						
Stroke[a]						
No Loss	7.81 [4.50, 13.51]	0.280	7.358	< .001	94.140	< .001
Vision Loss	2.80 [1.56, 5.03]	0.297	3.459	<.01		
Stroke	1.82 [.98, 3.41]	0.317	1.896	0.059		
Predicted Correct =73.1%						
Cox & Snell = 0.197 (0.063[b])						
Full Model						
Emphysema[a]						
No Loss	7.93 [3.76, 16.67]	0.380	5.451	< .001	81.657	< .001
Vision Loss	2.82 [1.31, 6.06]	0.388	2.678	<.01		
Emphysema	1.79 [.79, 4.05]	0.416	1.401	0.162		
Predicted Correct =72.9%						
Cox & Snell = 0.191 (0.064)						
Full Model						
Asthma[a]						
No Loss	5.18 [3.33, 8.06]	0.225	7.326	< .001	60.184	< .001
Vision Loss	1.92 [1.21, 3.04]	0.234	2.786	<.01		
Asthma	3.05 [1.94, 4.80]	0.230	4.857	< .001		
Predicted Correct =72.7%						
Cox & Snell = 0.184 (0.052[b])						

Table D2 (Continued)

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Cancer[a]						
No Loss	3.16 [2.32, 4.31]	0.157	7.343	< .001	57.613	< .001
Vision Loss	1.34 [0.79, 1.63]	0.182	0.709	0.479		
Cancer	2.88 [2.06, 4.03]	0.170	6.212	< .001		
Predicted Correct =72.3%						
Cox & Snell = 0.180 (0.048[b])						
Full Model						
Diabetes[a]						
No Loss	7.14[5.03, 10.20]	0.180	10.965	< .001	89.855	< .001
Vision Loss	2.68 [1.83, 3.92]	0.194	5.086	< .001		
Diabetes	2.63 [1.81, 3.85]	0.191	6.616	< .001		
Predicted Correct =73.6%						
Cox & Snell = 0.202 (0.077[b])						
Full Model						
Arthritis[a]						
No Loss	7.81 [3.21, 9.80]	0.115	17.923	< .001	153.49	< .001
Vision Loss	3.18 [2.27, 4.49]	0.173	6.716	< .001		
Arthritis	2.62 [2.10, 3.26]	0.112	8.598	< .001		
Predicted Correct =74.3%						
Cox & Snell = 0.221 (0.120[b])						
Full Model						
Depression[a]						
No Loss	4.25 [3.30, 5.46]	0.128	11.277	< .001	77.052	< .001
Vision Loss	1.53 [1.10, 2.12]	0.166	2.579	<.05		
Depression	2.34 [1.79, 3.05]	0.135	6.294	< .001		
Predicted Correct =72.5%						
Cox & Snell = 0.188 (0.060[b])						
Full Model						
Hearing[a]						
No Loss	3.43 [2.73, 4.31]	0.115	10.695	< .001	64.813	< .001
Vision Loss	1.18 [0.87, 1.61]	0.156	1.081	0.281		
Hearing	2.35[1.80, 3.09]	0.136	6.299	< .001		
Predicted Correct =72.3%						
Cox & Snell = 0.183 (0.055[b])						

Note. Controlling for Race/Ethnicity, Sex, Marital Status, Region, Health Status, and Age. Degrees of Freedom = 300. a = OR reverse computed for comparison of both conditions compared to all other groups. b = base model Cox & Snell

Table D3

Logistic regression: conditions by difficulty reading

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Hyertension[a]						
No Loss	9.09 [7.24,11.36]	.114	19.406	< .001	214.96	< .001
Vision Loss	1.30 [0.97,1.76]	.152	1.742	.083		
Hypertension	9.09 [7.35, 11.36]	.109	20.334	< .001		
Predicted Correct =81.3%						
Cox & Snell = 0.147 (0.128[b])						
Full Model						
Coronary Heart Disease[a]						
No Loss	9.62 [6.67, 13.70]	0.184	12.320	< .001	218.63	< .001
Vision Loss	1.18 [0.79, 1.74]	0.200	0.824	.411		
Coronary Heart Disease[a]	8.33 [5.55, 12.50]	0.207	10.247	< .001		
Predicted Correct =81.3%						
Cox & Snell = 0.146 (0.127[b])						
Full Model						
Heart Condition						
No Loss	8.62 [6.25, 11.90]	0.163	13.200	< .001	216.76	< .001
Vision Loss	1.04 [0.74, 1.47]	0.172	0.269	0.788		
Heart Condition	8.26 [5.74, 11.90]	0.187	11.307	< .001		
Predicted Correct =81.0%						
Cox & Snell = 0.149 (0.126[b])						
Full Model						
Stroke[a]						
No Loss	12.67 [5.54, 18.87]	0.200	12.673	< .001	222.34	< .001
Vision Loss	1.56 [1.03, 2.34]	0.209	2.117	<.05		
Stroke	8.20 [5.15, 12.99]	0.236	8.915	< .001		
Predicted Correct =81.2%						
Cox & Snell = 0.148 (0.129[b])						
Full Model						
Emphysema[a]						
No Loss	15.87 [8.19, 30.30]	0.344	8.264	< .001	215.27	< .001
Vision Loss	1.96 [1.02, 3.78]	0.322	2.031	<.05		
Emphysema	11.36 [5.34, 23.81]	0.381	6.364	<.01		
Predicted Correct =81.1%						
Cox & Snell = 0.147 (0.127[b])						
Full Model						
Asthma[a]						
No Loss	9.900[6.75,14.71]	0.196	11.735	< .001	298.00	< .001
Vision Loss	1.240 [0.82, 1.85]	0.208	0.621	0.309		
Asthma	9.620[6.21, 14.92]	0.223	10.146	< .001		
Predicted Correct =81.3%						
Cox & Snell = 0.147 (0.127[b])						

Table D3 (Continued)

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Cancer[a]						
No Loss	9.260 [6.85, 12.50]	0.152	14.592	< .001	224.53	< .001
Vision Loss	1.170 [0.83, 1.64]	0.172	0.900	0.369		
Cancer	9.990 [7.09, 13.89]	0.171	13.439	< .001		
Predicted Correct =81.1%						
Cox & Snell = 0.147 (0.127[b])						
Full Model						
Diabetes[a]						
No Loss	11.630 [8.33, 16.39]	0.171	14.366	< .001	299.00	< .001
Vision Loss	1.440 [1.00, 2.07]	0.184	1.988	<.05		
Diabetes	11.372[6.06, 12.82]	0.192	11.372	< .001		
Predicted Correct =81.6%						
Cox & Snell = 0.149 (0.131[b])						
Full Model						
Arthritis[a]						
No Loss	9.09 [7.24, 11.36]	0.113	19.532	< .001	219.006	< .001
Vision Loss	1.09 [0.81, 1.46]	0.147	0.581	0.562		
Arthritis	7.99 [6.37, 10.00]	0.113	18.312	< .001		
Predicted Correct =81.3%						
Cox & Snell = 0.147 (0.127[b])						
Full Model						
Depression[a]						
No Loss	10.41 [8.26,12.99]	0.116	20.181	< .001	225.514	< .001
Vision Loss	1.32 [1.01, 1.75]	0.139	2.045	<.05		
Depression	6.58 [6.58, 10.87]	0.127	16.764	< .001		
Predicted Correct =81.4%						
Cox & Snell = 0.148 (0.129[b])						
Full Model						
Hearing[a]						
No Loss	11.49 [8.93, 14.93]	0.128	19.043	< .001	213.89	< .001
Vision Loss	1.42 [1.06, 1.89]	0.146	2.423	<.05		
Hearing	7.69 [5.88, 10.10]	0.135	15.139	< .001		
Predicted Correct =81.5%						
Cox & Snell = 0.150 (0.132[b])						

Note. Controlling for Race/Ethnicity, Sex, Marital Status, Region, Health Status, and Age. Degrees of Freedom = 3,298. a = OR computed for comparison of both conditions compared to all other groups. b = base model Cox & Snell. CI = confidence interval

Table D4

Logistic regression: conditions by going out

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Hyertension[a]						
No Loss	5.38 [4.27, 6.75]	.117	14.431	< .001	75.23	< .001
Vision Loss	1.56 [1.15, 2.05]	.150	2.948	<.01		
Hypertension	3.39 [2.77, 4.67]	.103	11.891	< .001		
Predicted Correct =81.9%						
Cox & Snell = 0.168 (0.068[b])						
Full Model						
Coronary Heart Disease[a]						
No Loss	8.62 [5.64, 13.15]	0.214	10.030	< .001	97.139	< .001
Vision Loss	2.50 [1.62, 3.85]	0.220	4.174	< .001		
Coronary Heart Disease[a]	3.22 [2.04,5.05]	0.230	5.083	< .001		
Predicted Correct =82.5%						
Cox & Snell = 0.174 (0.074[b])						
Full Model						
Heart Condition						
No Loss	5.71 [4.04,8.06]	0.176	9.902	< .001	88.73	< .001
Vision Loss	1.55 [1.08,2.22]	0.185	2.370	<.05		
Heart Condition	2.72 [1.74,3.64]	0.187	4.929	< .001		
Predicted Correct =82.1%						
Cox & Snell = 0.172 (0.72[b])						
Full Model						
Stroke[a]						
No Loss	10.31 [6.53,16.39]	0.229	10.156	< .001	98.37	< .001
Vision Loss	2.94 [1.82,4.76]	0.243	4.440	< .001		
Stroke	2.49 [1.53,4.01]	0.244	3.729	< .001		
Predicted Correct =82.3%						
Cox & Snell = 0.179 (0.083[b])						
Full Model						
Emphysema[a]						
No Loss	12.19 [6.53,22.72]	0.318	7.876	< .001	84.613	< .001
Vision Loss	3.58 [1.90,6.71]	0.320	3.984	< .001		
Emphysema	3.70 [1.91,6.71]	0.364	3.601	< .001		
Predicted Correct =82.3%						
Cox & Snell = 0.171 (0.068)						
Full Model						
Asthma[a]						
No Loss	6.370 [4.13,9.80]	0..220	8.397	< .001	73.802	< .001
Vision Loss	1.860 [1.18,2.92]	0.230	2.701	<.01		
Asthma	3.400 [2.11,5.46]	0.242	5.056	< .001		
Predicted Correct =82.1%						
Cox & Snell = 0.168 (0.061[b])						

Table D4 (Continued)

Variable	Odds [C.I.]	Std. Error	t	p	Wald	p
Full Model						
Cancer[a]						
No Loss	4.230 [3.07,5.81]	0.162	8.894	< .001	67.415	< .001
Vision Loss	1.250 [.88,1.77]	0.178	1.229	0.220		
Cancer	3.870 [2.79,5.34]	0.165	8.178	< .001		
Predicted Correct =82.2%						
Cox & Snell = 0.163 (0.056[b])						
Full Model						
Diabetes[a]						
No Loss	8.260 [2.04,5.05]	0.180	11.752	< .001	87.065	< .001
Vision Loss	2.460 [2.04,5.05]	0.195	4.607	< .001		
Diabetes	3.332 [2.04,5.05]	0.194	6.192	< .001		
Predicted Correct =82.2%						
Cox & Snell = 0.179 (0.078[b])						
Full Model						
Arthritis[a]						
No Loss	9.17 [7.19,11.63]	0.122	18.181	< .001	121.248	< .001
Vision Loss	2.59 [1.85,3.61]	0.169	5.635	< .001		
Arthritis	3.02 [2.42,3.77]	0.113	9.797	< .001		
Predicted Correct =82.4%						
Cox & Snell = 0.191 (0.105[b])						
Full Model						
Depression[a]						
No Loss	6.21 [4.73,8.13]	0.137	13.295	< .001	86.180	< .001
Vision Loss	1.75 [1.24,2.47]	0.174	3.234	<.01		
Depression	2.69 [2.02,3.57]	0.144	6.849	< .001		
Predicted Correct =82.3%						
Cox & Snell = 0.175 (0.076[b])						
Full Model						
Hearing[a]						
No Loss	5.74 [4.46,7.35]	0.127	13.705	< .001	81.251	< .001
Vision Loss	1.76 [1.31,2.38]	0.152	3.719	< .001		
Hearing	3.34 [2.50,4.46]	0.147	8.190	< .001		
Predicted Correct =81.9%						
Cox & Snell = 0.170 (0.067[b])						

Note. Controlling for Race/Ethnicity, Sex, Marital Status, Region, Health Status, and Age. Degrees of Freedom = 300. a = OR reverse computed for comparison of both conditions compared to all other groups. b = base model Cox & Snell. CI = confidence interval