Visual Impairment and Eye Care among Older Americans: Secondary Analysis of the Behavioral Risk Factor Surveillance System (BRFSS)

Amy L. Freeland
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VISUAL IMPAIRMENT AND EYE CARE AMONG OLDER AMERICANS: SECONDARY ANALYSIS OF THE BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM (BRFSS)

by

Amy L. Freeland

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Submitted to the
Faculty of The Graduate College
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requirements for the
Degree of Doctor of Philosophy
Interdisciplinary Health Sciences
Advisor: Robert Shawn Wall Emerson, Ph.D.

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Kalamazoo, Michigan
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CHAPTER I

INTRODUCTION

National estimates of the population of Americans experiencing vision loss range from 3 million (over the age of 40) (Eye Diseases Prevalence Research Group, 2004), to 21 million (age 18 and over) (Pleis & Lethbridge-Cejku, 2007). The lack of precision in estimating this population mirrors the lack of knowledge about the characteristics and behaviors of people who experience vision loss. Imprecise population estimates and lack of knowledge about the health behaviors in this population impede the development of rational policies and programs to serve them. The goal of these three papers is to explore three issues relevant to public health dimensions of vision loss. The aim of the first paper is surveillance, providing a state-level examination of the characteristics of people with vision loss, self-reported eye diseases associated with aging, eye health care access, and behaviors in four states utilizing the Behavioral Risk Factor Surveillance System (BRFSS), Visual Impairment and Access to Eye Care Module and the Diabetes Module in 2007. The aim of the second and third papers is risk factor identification, specifically exploring factors related to access to care for the prevention and monitoring of vision-threatening eye pathologies. The second paper examines 3 years of BRFSS data from 11 states to identify predictive relationships between vision loss, eye care access, social demographic characteristics, and eye doctor visits. The third paper builds upon the second by examining the same 3 years of BRFSS data but looks specifically at the subpopulation of people with diagnosed diabetes in order to explore the predictive relationship between
the visual impairment, eye disease including diabetic retinopathy, diabetes health management, and eye care.

Visual Impairment and Public Health

Historically, the field of rehabilitation has been concerned with health on an individual level, striving to restore an individual to pre-trauma or pre-loss functioning and independence. The same is true in the fields of vision rehabilitation (vision rehabilitation therapy, orientation and mobility, and low vision therapy), where clinicians are concerned with such skills as independent health monitoring (e.g., blood glucose monitoring, prescription drug label accessibility), hygiene and cleanliness (e.g., personal management skills, systematic cleaning techniques), social participation, and environmental access (e.g., transportation management, wayfinding, and community access). However, investigators in public health and those in vision rehabilitation have recently drawn broader connections between vision rehabilitation and population health, recognizing the critical link between prevention activities, healthcare access, and universal design in avoiding visual impairment when possible, managing chronic diseases that lead to visual impairment and other disabling conditions, preventing comorbid and secondary conditions (Crews, Jones, & Kim, 2006), and promoting healthy and independent living regardless of disability status.

Vision impairment has been identified by investigators at the Centers for Disease Control and Prevention as a significant public health concern (Crews & Campbell, 2004; Crews et al., 2006; Lollar & Crews, 2003; Saaddine, Narayan, & Vinicor, 2003; Zhang et al., 2008). Prevalence studies indicate high rates of comorbid and secondary conditions
among people with severe visual impairments. When those increasing rates are applied to swelling population numbers, the result is a significant upsurge in the number of people living with these health circumstances. Comorbid conditions are defined as coexisting or concomitant diseases that have unrelated pathologies (American Heritage Medical Dictionary, 2007). Secondary conditions are defined as preventable physical, mental, and social disorders that result directly or indirectly from an initial disabling condition (Kinne, Patrick, & Doyle, 2004). A number of studies have demonstrated the association between vision loss and other health conditions, including higher rates of hip fracture (Cummings et al., 1995; Felson et al., 1989), poor nutrition (Tumosa, 2008), depression (Brody et al., 2001; Rovner & Ganguli, 1998), medication errors (Tumosa, 2008), cognitive deterioration (Lin et al., 2004), arthritis (Nevitt, Cummings, Kidd, & Black, 1989), infection (Tumosa, 2008), falls (Dunlop et al., 2005; Tumosa, 2008), and mortality (Tumosa, 2008; Wang, Mitchell, Simpson, Cumming, & Smith, 2001). These associated events place this population at increased risk of high healthcare and rehabilitation services utilization and increases the potential for diminished quality of life. Other common comorbid conditions for people with visual impairments include breathing problems, depression, diabetes, hearing impairment, cardiac diseases, hypertension, joint symptoms, low back pain, and stroke (Crews et al., 2006), with diabetes being one of the leading chronic diseases of concern (National Institutes of Health, 2008) for healthcare professionals, investigators, advocates, policy makers, and program planners. Diabetes also increases the consequences of common comorbid eye conditions such as dry eye syndrome, cataracts, macular edema, neovascularization, and macular degeneration,
adding an additional layer of health concern for those living with diabetes (Tumosa, 2008).

The economic consequences of vision loss and eye diseases are also of national concern. Recent reports indicate that the annual impact of major eye problems in the United States results in approximately $51 billion annually (Frick, Gower, Kempen, & Wolff, 2007; Rein et al., 2006). These expenditures are a result of direct medical fees, informal care, and other direct costs such as nursing home care, decreased health utility, and lost wages. While controversial, some investigators go a step further to calculate the impact of the experience of living with a disability through adjusting life years based upon quality and determine cost-utility of intervention, which is yet another facet of the economic impact (Frick et al., 2007; Rein et al., 2006).

Population-based research shows that the prevalence of visual impairment is increasing at an alarming rate which, when layered on the growing population numbers, results in significant cause for concern. According to a 2007 National Health Interview Survey (NHIS) report, an estimated 9.5%, or 21.2 million, of the United States non-institutionalized population reported having trouble seeing even when wearing glasses or contact lenses in 2006 (Pleis & Lethbridge-Cejku, 2007). That estimate increased from a previous level of 8.8% or 19.1 million in 2004 (Lethbridge-Cejku, Rose, & Vickerie, 2006). Predicted increases in prevalence of severe visual impairment have been well documented and are attributed to a variety of factors, including increasing incidence of age-related visual impairments; diabetes, HIV, and other systemic diseases; and the indirect result of the advances in life-sustaining medical technologies (Eye Diseases Prevalence Group, 2004). The compounding effect of increasing prevalence rates along
with an aging population will be dramatic in the coming years. In fact, for people aged 40 years and older, eye conditions that lead to blindness and low vision are expected to increase dramatically by 2020. For example, between 2004 and 2020 the predicted population of Americans experiencing cataracts will increase from 20.5 million to 30.1 million, and the population of Americans experiencing diabetic retinopathy will increase from 4.1 million to 7.2 million. Similar increases will occur in the population of Americans experiencing glaucoma, from 2.2 million to 3.3 million, and age-related macular degeneration, from 1.8 million to 2.9 million, with an additional 7.3 million Americans aged 40 years and older who are at substantial risk for vision loss from age-related macular degeneration due to genetic predisposition, personal health choices such as smoking, and medication/vitamin use (Age-Related Eye Disease Study Research Group, 2001; Eye Diseases Prevalence Group, 2004).

Prevention and control of major eye conditions are available and are generally effective; yet research indicates that access to eye care remains a major problem (Zhang et al., 2008). Public health investigators have recently begun to examine the interaction between demographic and environmental factors that may influence people's decisions and ability to go to their eye-care professional or may serve as barriers to access. Zhang et al. (2008) explored the measurement of access to eye care, noting that access is multidimensional and includes various individual and contextual factors. Individual factors include demographics, health beliefs, immigrant status, insurance coverage, availability of health information, risk behaviors such as smoking, and vision problems. Contextual factors, however, include community characteristics such as crime rates, community composition by demographics, per capita income, the number of available
eye-care professionals, and population health indices (Zhang et al., 2008). Zhang et al. also noted that while there may be a high potential for eye-care access, actual use of eye-care services, patient satisfaction, and correlated outcomes may reveal discrepancies to access. Zhang and his colleagues further pointed out that it is vital to monitor and predict the use of eye-care services as well as prevent vision loss when possible and promote eye health, using the data sources that reflect the many variables that have influence on access, such as the Behavioral Risk Factor Surveillance System (BRFSS, 2009).

Determinants of Health

There are many factors that, when combined, affect the overall health of individual people as well as communities. Whether people are healthy is determined, in part, by their life circumstances or the environment in which they live (World Health Organization [WHO], 2008). Factors such as income level, education, genetics, location of residence, and relationships with family and friends all have significant influences on health and can have a considerable impact on access to and use of health care services (Centers for Disease Control and Prevention [CDC], 2009; The Secretary’s Advisory Committee on National Health Promotion and Disease Prevention Objective for 2020, 2008). This mix of variables can lead to disparities in health status resulting in health inequalities. The term health disparity is most commonly defined in public health in the U.S. as a particular type of health difference that adversely affects groups of people who have systematically experienced greater social or economic obstacles to health based on their race/ethnicity, socioeconomic status, gender, disability status, and other characteristics historically linked to discrimination or exclusion (Carter-Pokras & Baquet,
Commonly recognized factors related to health disparities in the U.S. include race/ethnicity, socioeconomic status, gender, age, geography, and disability status. Early drafts of Healthy People 2020 recognized the importance of identifying health disparities and healthcare inequity in order to quantify the need for programs and policy initiatives and mark progress over time.

People living with disabilities, specifically visual impairments, can be classified with those who have historically experienced health disparity and healthcare inequity. The experience of living with a significant visual impairment is multidimensional, including the physical manifestation of the disease causing the impairment, functional limitations in physical activity and social participation, and environmental and personal factors that serve as barriers or facilitators to healthy living. A conceptual framework embracing this complex schema is the International Classification of Functioning, Disability and Health (ICF, 2008). The ICF is the World Health Organization's framework for measuring health and disability at individual, group, and population levels (WHO, 2008). It was endorsed by the 191 WHO member states in May 2001 (resolution WHA 54.21), and the Fifty-fourth World Health Assembly encouraged all member states to use the ICF in their surveillance, reporting, and research as a means for standardized and comparable health data (WHA 54.21 Agenda item 13.9, 2001). The ICF is an integrated model meshing body functions and structures (anatomy/biology), health conditions (diseases or disorders), activities (personal or environmental factors), and participation (involvement in life situations) (Hendershot, Placek, & Goodman, 2006; International Classification of Functioning [ICF], 2008) (see Figure 1-1). The ICF is a
useful tool for framing health related assessment survey questions in order to gain insight into the conceptual clarity of the questions.

In this framework (Figure 1-1), a health condition (disorder or disease) is one that may result in changes in body structures and functions, limitations in activities, and restrictions in social participation. Crafters of the ICF model have clearly defined each domain. Body structures and functions include such things as sensory functions and changes in physiological function of body systems. Activities include such things as self-care, mobility, and applying knowledge. Participation includes interpersonal activities and contributions to domestic, community, and civic life.

![Figure 1-1. International Classification of Functioning and Disability Model (ICF, 2008)]
In addition to health conditions, body functions, activities, and participation, the ICF model also includes environmental and personal factors. Environmental factors may comprise the natural or built environment, supports and relationships, attitudes, policies, and services. Personal factors can also be fitted to the ICF and may consist of demographic factors (gender, race/ethnicity, age, level of education, and income). The ICF model is not intended to be used as an evaluation tool, but simply a framework by which to structure the multifaceted experience of living with a disability (Crews, Saaddine, Zhang, & Jones, 2009). An example may demonstrate the usefulness of the ICF. A 70-year-old white woman (personal characteristics) with diagnosed glaucoma (a disease) may experience changes to her optic nerve leading to a measurable reduction in acuity (function). The result of this acuity change is difficulty shopping, cooking, reading, and getting from one place to another safely (activity). Because it is difficult to get from one place to another (activity), to read a menu (activity) in a dark restaurant (environment), or to shop (activity) in a crowded store (environment), this person may decide not to spend time with friends in the way she once did (participation).

A population-level survey that addresses health determinants and can also be structured around the ICF is the Behavioral Risk Factor Surveillance System (BRFSS, 2009). This survey focuses on health risk behaviors, preventive health practices, and health care access and also includes questions about visual functioning and disability. The BRFSS relies on self-reported data and helps to identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs (CDC, 2009). It is comprised of a core set of 83 health-related questions and approximately 25 additional subject-specific modules that states have the option to
implement each year. Two modules especially beneficial to the field of visual impairment are the Visual Impairment and Access to Eye Care Module and the Diabetes Module. These modules ask questions related to condition (disease), activity limitation, and environment/participation (Crews et al., 2009). Tables 1-1 and 1-2 contain the BRFSS, Visual Impairment and Access to Eye Care Module and Diabetes Module questions that will be used throughout this investigation which have been fitted within the ICF domains. Structuring BRFSS survey questions to the ICF not only aids in identifying the particular experiential domain in which the responses lie, but it will also assist investigators in isolating solutions to areas of inequality or barriers to care.

In order to fully understand the population of people with visual impairments or at risk of visual impairments, it is vital to understand (a) who is getting regular eye exams by an eye-care professional; (b) what factors influence eye-care use (examples: having optical insurance, personal or family history of eye disease, fluctuations in functional visual performance, etc.); and (c) whether having a chronic disease such as diabetes and the management of that disease change the vision, personal health, and vision health habits of those with the disease compared with those who do not have the disease.

Related Purposes of the Three Studies

These three studies are independent, yet interrelated (see Figure 1-2). The foundation of these studies is the description of the characteristics and circumstances of the population at the state level. From that foundation, investigators will explore the social demographic, visual impairment, and eye-care patterns that inform eye-care use for
Table 1-1

*BRFSS Visual Impairment and Access to Eye Care Module Questions Fitted to the ICF*

<table>
<thead>
<tr>
<th>Disease</th>
<th>Structure/Function</th>
<th>Activity</th>
<th>Environment/Participation</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you been told by an eye doctor or other professional that you NOW have cataracts?</td>
<td></td>
<td>How much difficulty, if any, do you have in recognizing a friend across the street?</td>
<td>When was the last time you had your eye examined by a doctor or eye-care professional?</td>
<td>What is your age?</td>
</tr>
<tr>
<td>Have you EVER been told by an eye doctor or other health care professional that you have glaucoma?</td>
<td></td>
<td>How much difficulty, if any, do you have in reading print in newspaper, magazine, recipe, menu, or numbers on the telephone?</td>
<td>What is the main reason you have not visited an eye-care professional in the past 12 months?</td>
<td>Are you Hispanic or Latino? What is your race?</td>
</tr>
<tr>
<td>Have you EVER been told by an eye doctor or other health professional that you had age-related macular degeneration?</td>
<td></td>
<td></td>
<td>When was the last time you had your pupils dilated?</td>
<td>What is the highest grade or year of school completed?</td>
</tr>
<tr>
<td>Have you EVER had an eye injury that occurred at your workplace while you were doing your work?</td>
<td></td>
<td>Do you have any kind of insurance for eye care?</td>
<td>What is your annual household income?</td>
<td>What is your gender?</td>
</tr>
</tbody>
</table>
### Table 1-2

**BRFSS Diabetes Module Questions Fitted to the ICF**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Structure/Function</th>
<th>Activity</th>
<th>Environment/Participation</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been told by a doctor that you had diabetes?</td>
<td>Are you taking insulin?</td>
<td>About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?</td>
<td>How old were you when you were told that you have diabetes?</td>
<td></td>
</tr>
<tr>
<td>Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?</td>
<td>Are you taking diabetes pills?</td>
<td>About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for A1C?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>About how often do you check your blood for glucose or sugar?</td>
<td>Have you ever taken a course or class in how to manage your diabetes yourself?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

people ages 40 years and older in both the general population and the subpopulation of people with diagnosed diabetes.

*Study one* examined the 2007 BRFSS Visual Impairment and Access to Eye Care Module data to provide the most recent descriptive analysis of state-level data regarding visual impairment (VI) (self-reported VI, specific eye disease/injury) and eye care (eye-care insurance, dilated eye exams, eye-care professional visits, and reason for choosing to go to the eye-care professional) for Alabama, Georgia, Iowa, and West Virginia (states that utilized both the Visual Impairment and Access to Eye Care Module and the Diabetes
Module in 2007). State-level data were examined for prevalence of eye conditions (macular degeneration, cataracts, diabetic retinopathy, workplace eye injuries). Data were aggregated to explore combined data on demographic, eye care, and health-related variables of interest.

Figure 1-2. Project Flow Chart

Study two aggregated data from the years 2005, 2006, and 2007 in order to examine the predictive relationships between whether a person has vision loss, health care access, eye-care access, health behaviors, social demographic circumstances, and eye doctor visits. Data were aggregated to ensure a large enough sample size to provide power for the complex analysis design. States that completed the Visual Impairment and Access to Eye Care Module in 2005, 2006, and 2007 were Alabama, Arizona, Florida, Georgia, Louisiana, New York, Ohio, Tennessee, Texas, and West Virginia.
Study three also used aggregated data from 2005, 2006, and 2007. This investigation linked data from the Visual Impairment and Access to Eye Care Module and the Diabetes Module to examine the predictive relationship between this chronic disease and visual impairment, diabetes health care, and eye care specifically for the subpopulation of people with diagnosed diabetes.

The questions posed in the current multi-part study are intended to inform health policy, vision health programs, clinical eye-care professionals, and primary medical care providers by identifying predictive relationships between medical conditions, personal characteristics, and behaviors such as visits to an eye-care professional. Identification of these predictive relationships, with particular focus on the effects of diabetes, will help policy makers and health advocates track health care trends, allow health programs to plan for future needs, and assist eye care and primary care professionals to better screen patients and address patient needs, including referrals to other agencies and professionals.

References


CHAPTER II

VISUAL IMPAIRMENT AND ACCESS TO EYE CARE AMONG OLDER AMERICANS

Background/Significance

Few things are as fundamental to professionals in the field of blindness and low vision as timely, accurate information about the population experiencing visual impairment. Prevalence and population estimates provide basic information to identify rehabilitation and healthcare programs, provide guidance to agencies responding to consumer needs, and inform consumers and professionals on population trends. More intense investigations serve to identify the characteristics of people who may benefit from targeted service provision. Until 2005, state-specific prevalence estimates of visual impairment, eye disease/injury, and access to eye care were not available and were approximated from national prevalence rates. In 2005 the Centers for Disease Control and Prevention introduced the Vision Impairment and Access to Eye Care Module as a part of the Behavioral Risk Factors Surveillance System (BRFSS). This survey for the first time allowed investigators to estimate state level vision data. Bailey et al. (2006) analyzed 2005 BRFSS to estimate the prevalence of visual impairment, eye diseases, and eye-care access in five states—Iowa, Louisiana, Ohio, Tennessee, and Texas—and found significant state level variations in prevalence rates of visual impairment and access to eye care in addition to variability in demographic characteristic among those five states. Based on those findings, Bailey et al. recommended further exploration of state-level data
in order to provide benchmark data, monitor program and policy effectiveness, and help identify areas of health inequity. This study, therefore, explored the 2007 BRFSS Visual Impairment and Access to Eye Care Module data to estimate current prevalence estimates of visual impairment, eye disease/injury, and access to eye care. Four states—Alabama, Iowa, Georgia, and West Virginia—implemented both the Visual Impairment and Access to Eye Care Module and the Diabetes Module in 2007. These data were released in early 2008 and therefore represent the most recent state-level data available. This foundational investigation will explore the BRFSS Visual Impairment and Access to Eye Care Module and Diabetes Module to describe the population with regard to prevalence of visual impairment, eye disease/injury, and eye care for the states that implemented both modules in 2007.

Determinants of Health

There are many factors that, when combined together, affect the overall health of individuals and communities. Health status is often determined by a person’s life circumstances or by the environment in which they live (World Health Organization [WHO], 2009). Factors such as income level, education, genetics, where people live, and relationships with family and friends all have significant influences on health and can have a considerable impact on access to and use of health care services. This complicated mix of variables can lead to disparities in health status resulting in health inequalities. The term health disparity is most commonly defined in public health as a particular type of health difference that adversely affects groups of people who have systematically experienced greater social or economic obstacles to healthcare based on their
race/ethnicity, geography, socioeconomic status, gender, disability status, and other characteristics historically linked to discrimination or exclusion (Carter-Pokras & Baquet, 2002; Centers for Disease Control and Prevention [CDC], 2009; The Secretary’s Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020, 2008). In order to address inequalities in health, disparities must first be identified.

People living with disabilities, specifically visual impairments, may be regarded as among those who have experienced health disparity and healthcare inequity in the past (Crews & Lollar, 2008). Previous research indicates variations in certain eye diseases by race (e.g., rates of glaucoma are higher in blacks and macular degeneration is higher in whites [Bailey et al., 2006]), age (e.g., rates of age-related macular degeneration, cataracts increase with age [Bailey et al., 2006]), and geographic distribution (e.g., Southern states report higher rates of impairment than Midwestern states [Bailey et al., 2006]). Similarly, access to eye care is associated with socioeconomic status, particularly levels of education (Bailey et al., 2006). Therefore, investigators at the intersection of vision rehabilitation (i.e., vision rehabilitation therapists, orientation and mobility specialists, and low vision therapists) and public health (i.e., epidemiologists, community health specialists) have begun to recognize the critical link between their disciplines. This foundational work has primarily centered on identifying the need to converge the population health focus of the public health research and the individual health focus of the rehabilitation therapist into an interdisciplinary system of health inclusion by which investigators identify disparities in eye health and work toward health equity (Crews, 2003; Crews, Jones, & Kim, 2006; Crews, Kirchner, & Lollar, 2006; DiStefano, Huebner, Garber, & Smith, 2006;
Hendershot, Placek, & Goodman, 2006; Janiszewski, Health-Watson, Semidey, Rosenthal, & Do, 2006; Kirchner, 2006). The next steps in this interdisciplinary work will weave together prevention and education activities, healthcare access, and universal design in order to avoid visual impairment when possible, and manage chronic diseases that lead to visual impairment and other disabling conditions. Investigators who find themselves at this interdisciplinary crossroads will also investigate ways to prevent comorbid and secondary conditions and promote healthy and independent living regardless of disability status (Crews, Jones, et al., 2006). Therefore, this current project will advance the new interdisciplinary public health/vision rehabilitation agenda.

The loss of vision has profound implications for individuals as well as those who care for and about them. It affects the ability to manage everyday tasks and may limit social roles. The experience is multidimensional, with an interesting and complex interaction between the physical manifestation of the disease causing the impairment, its impact on physical activity and social participation, and the environmental and personal factors that serve as barriers or facilitators to healthy living. A conceptual framework that takes into account this multidimensional experience is the *International Classification of Functioning, Disability and Health* (ICF). The ICF is the World Health Organization’s (WHO) framework for measuring health and disability at both individual, group, and population levels (WHO, 2008). It was endorsed by the 191 WHO member states in May 2001 (resolution WHA 54.21) and the Fifty-fourth World Health Assembly encouraged all member states to use the ICF in their surveillance, reporting, and research as a means for standardized and comparable health data (WHA 54.21 Agenda item 13.9, 2001). The ICF is an integrated model meshing body functions and structures (anatomy/biology),
health conditions (diseases or disorders), activities (personal or environmental factors), and participation (involvement in life situations) (Hendershot et al., 2006; International Classification of Functioning [ICF], 2008) (see Figure 2-1). The ICF is not intended to function as an assessment tool, but rather as a conceptual model useful for understanding the multiple layers impacted by disability. It also serves as a structure on which to frame health-related assessment survey questions and to gain insight into the conceptual clarity of the questions.

Figure 2-1. International Classification of Functioning and Disability Model (ICF, 2008)

The Behavioral Risk Factor Surveillance System (BRFSS), utilized by Bailey et al. in 2006 to estimate the prevalence of visual impairment and access to eye care, is a population-level health-related survey that addresses health determinants and can also be
structured to fit the ICF. The BRFSS focuses on health risk behaviors, preventive health practices, and health care access and also includes questions about visual functioning and disability. It is a state-based system of health surveys that collects information about health care access and use, clinical preventive health practices, and health risk behaviors primarily related to injury and chronic disease.

The BRFSS consists of three-parts: (a) the fixed core component is used by all states and gathers demographic information including age, sex, race/ethnicity, income, and education as well as current behaviors that affect health (e.g., tobacco use, frequency of physical activity); (b) optional modules that include standardized questions about specific health-related topics (e.g., childhood asthma, cardiovascular health, sexual health); and (c) state add-on questions that may gather information about regional health concerns. The core survey consists of 83 questions, while the optional modules range from only 4 questions to as many as 13, and the number of state add-on questions is left to state discretion. The BRFSS is a cross-sectional random digit-dialed telephone survey conducted by state health departments with the Centers for Disease Control and Prevention providing financial, technical, and methodological assistance, as well as assistance in aggregating and distributing monthly data. Each state conducts the survey using standard “core” questions, as well as optional modules that are topic specific, all of which are standardized.

Two modules that are of significant interest to the field of vision are the Visual Impairment and Access to Eye Care Module and the Diabetes Module. Both modules provide important information about visual impairment, eye disease/injury, chronic disease strongly linked to vision loss (diabetes), and access to eye care (Crews, Saaddine,
Zhang, & Jones, 2009). The BRFSS Visual Impairment and Access to Eye Care Module is comprised of 10 questions related to condition (cataract, glaucoma, and macular degeneration), body functions and structures (injury), activity (reads the newspaper or recognizes a friend from a distance), participation in life activities (visits their eye-care professional), and environment facilitators (health insurance) and barriers (cost/insurance, do not have/know an eye doctor). All participants surveyed by the states that implement this module are aged 40 and over. There is 1 question in the core survey related to diabetes (diagnosis of diabetes), and the Diabetes Module contains 12 additional questions regarding age of onset of the disease, the respondent’s current medication habits (i.e., insulin, pills), diabetes management habits (e.g., frequency of blood glucose and A1C monitoring, foot care, participation in diabetes education course), and eye health activities (e.g., visit to eye doctor).

The purpose of this study was to establish updated prevalence estimates of self-reported visual impairment, eye disease/injury, and participation in eye care. This investigation used the 2007 BRFSS Visual Impairment and Access to Eye Care Module, with an additional response regarding the presence of diagnosed diabetic retinopathy taken from the Diabetes Module, to address the following two research questions:

1. What is the prevalence of people in Alabama, Georgia, Iowa, and West Virginia aged ≥40 years who report a visual impairment, cataract, glaucoma, macular degeneration, diabetic retinopathy, workplace injury, possession of eye-care insurance, recent history (within the past 12 months) of a dilated eye examination, recent history (within the past 12 months) of an eye-care professional visit, and reasons for deciding to go/not go to the eye-care
professional by demographic variables (state, age, gender, race/ethnicity, education, annual household income)?

2. What are the characteristics of people who do or do not visit their eye-care professional?

Methods

Study Design

The 2007 BRFSS is a state-based, random-digit-dialed telephone survey of the noninstitutionalized, U. S. civilian population aged ≥18 years. Investigators in this study conducted a secondary data analysis of the 2007 BRFSS Visual Impairment and Access to Eye Care and Diabetes Modules in order to provide the most recent descriptive profile of state-level visual impairment (VI) and eye-care data for Alabama, Georgia, Iowa, and West Virginia (states that utilized both the Visual Impairment and Access to Eye Care Module and Diabetes Modules in 2007). State-level data were examined for prevalence of eye conditions (macular degeneration, cataracts, diabetic retinopathy, and workplace eye injuries), percentage of people with eye-care insurance, and frequency of dilated eye exams and eye-care professional visits, as well as reasons for whether or not a respondent chose to go to an eye-care professional. Participants were included in the study if they answered questions in both the BRFSS Visual Impairment and Access to Eye Care Module and the diabetic retinopathy question from the Diabetes Module in the same year. The data were obtained from telephone interviews with 23,606 people aged 40 and over who completed both modules in 2007.
Measures

Demographic variables were taken from the 2007 BRFSS core survey (see Box 2-1). Respondents were classified as having a visual impairment affecting distance vision if they answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to the question, “How much difficulty, if any, do you have in recognizing a friend across the street?” They were classified as having a near vision visual impairment if they answered similarly to the question “How much difficulty, if any, do you have in reading print in newspaper, magazine, recipe, menu, or numbers on the telephone?” (BRFSS, 2008, p. 37). Severe vision impairment (near or distance) was defined as a response of “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to either of the two vision questions (see Box 2-2). A person with a cataract was identified by a positive response to the question, “Have you been told by an eye doctor or other health care professional that you NOW have cataracts?” This question also has a response “Yes, but had them removed,” which technically is a “no” response; however, prevalence of self-reported cataract removal was reported in this study as it reflects access to care. A person with glaucoma was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?” A person with macular degeneration was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?” A person with a workplace eye injury was identified by a positive response to the question, “Have you EVER had an eye injury that occurred at your workplace while you were doing your
work?” (see Box 2-2). A person with diabetic retinopathy was identified from the BRFSS Diabetes Module if a respondent answered “yes” to the question, “Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?” (BRFSS, 2008, p. 36). Access to eye care was measured by the response to two questions: “When was the

### Box 2-1. BRFSS Core Questions Used

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.1</td>
<td>What is your age? (Continuous variable)</td>
</tr>
<tr>
<td>12.2</td>
<td>Are you Hispanic or Latino? Yes/no</td>
</tr>
<tr>
<td>12.3</td>
<td>Which one or more of the following would you say is your race? White, Black or African-American, Asian, Native American or Other Pacific Islander, Other [specify], No additional choices, Don’t know</td>
</tr>
<tr>
<td>12.8</td>
<td>What is the highest grade or year of school you completed? Never attended school or only attended kindergarten, Grades 1-8 (elementary), Grades 9-11 (some high school), Grade 12 or GED (high school), College 1 year to 3 years (some college or technical school), College 4 years or more (college graduate)</td>
</tr>
<tr>
<td>12.10</td>
<td>Is your annual household income from all sources— Less than $10,000, Less than $15,000, Less than $20,000, Less than $25,000, Less than $35,000, Less than $50,000, Less than $75,000, $75,000 or more</td>
</tr>
<tr>
<td>12.20</td>
<td>Indicate sex of respondent: male/female</td>
</tr>
</tbody>
</table>
BRFSS Visual Impairment and Access to Eye Care Module Questions Used:

1. How much difficulty, if any, do you have in recognizing a friend across the street? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don't know
   h. Not applicable (blind)
   i. Refused

2. How much difficulty, if any, do you have reading print in a newspaper, magazine, recipe, menu, or numbers on the telephone? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don't know
   h. Not applicable (blind)
   i. Refused

3. When was the last time you had your eyes examined by any doctor or eye care provider?
   a. Within the past month
   b. Within the past year
   c. Within the past 2 years
   d. 2 or more years ago
   e. Never
   f. Don't know
   g. Not applicable (blind)
   h. Refused

4. What is the main reason you have not visited an eye care professional in the past 12 months?
   a. Cost/insurance
   b. Do not have/know an eye doctor
   c. Cannot get to the office/clinic (too far away, no transportation)
   d. Could not get an appointment
   e. No reason to go (no problem)
   f. Have not thought of it
   g. Other
   h. Don't know
   i. Not applicable (blind)
   j. Refused

(continued on next page)
5. When was the last time you had an eye exam in which your pupils were dilated? This would have made you temporarily sensitive to bright light.
   a. Within the past month
   b. within the past year
   c. Within the past 2 years
   d. 2 or more years ago
   e. Never
   f. Not applicable (blind)

6. Do you have any kind of health insurance coverage for eye care?
   a. Yes
   b. No
   c. Not applicable (blind)

7. Have you been told by an eye doctor or other health care professional that you NOW have cataracts?
   a. Yes
   b. Yes, but had them removed
   c. No
   d. Not applicable (blind)

8. Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?
   a. Yes
   b. No
   c. Not applicable (blind)

Age-related Macular Degeneration (AMD) is a disease that blurs the sharp, central vision you need for "straight ahead" activities such as reading, sewing, and driving. AMD affects the macula, the part of the eye that allows you to see fine detail.

9. Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?
   a. Yes
   b. No
   c. Not applicable (blind)

10. Have you EVER had an eye injury that occurred at your workplace while you were doing your work?
    a. Yes
    b. No

Box 2-2. BRFSS Visual Impairment and Access to Eye Care Module Questions Used

last time you visited any eye-care professional?" and “When was the last time you had an eye exam in which your pupils were dilated?” Answers were then coded to reflect
whether the respondent visited their eye-care professional and/or had a dilated eye exam in the last 12 months. Access to eye care was further explored using the questions: “Do you have any kind of health insurance coverage for eye care?” and “What is the main reason you did not visit an eye-care professional in the preceding 12 months?” (BRFSS, 2008, pp. 37-40) (see Box 2-2).

Data Analysis

Data were analyzed using SPSS version 16.0 Complex Samples Module to account for the multi-stage, complex survey design methods of the BRFSS (SPSS, 2007). Stratification and weights were used and standard errors were adjusted using stratum information provided in the 2007 BRFSS Codebook (BRFSS, 2008). Cross-tabulation analyses provided prevalence estimates and confidence intervals of state-level data based on demographic information (e.g., age, sex, race/ethnicity, education, and annual household income) and for variables related to visual impairment (VI) (e.g., self-reported VI, specific eye disease/injury) and eye care (e.g., eye-care insurance, dilated eye exams, eye-care professional visits, and reason for choosing to go to the eye-care professional) for Alabama, Georgia, Iowa, and West Virginia (states that utilized both the Vision and Diabetes Modules in 2007). State-level data were also examined for prevalence of eye conditions (macular degeneration, cataracts, diabetic retinopathy, and workplace eye injuries). Data were then aggregated to present combined data on demographic, eye care, and health related variables of interest. Data were further explored to determine differences among groups (age, gender, race/ethnicity, educational level, and household income).
Results

A total of 23,606 responses were analyzed using statistical software to account for survey design complexity. The self-reported prevalence of visual impairment and eye disease among persons aged ≥40 years varied among the four states that used both the Visual Impairment and Access to Eye Care Module and Diabetes Module in 2007. The prevalence of a “distance vision” visual impairment (unable to recognize a friend from across the street) varied by definition of visual impairment. When using a broad case definition of vision impairment (any difficulty at all), the prevalence ranged from 12% (95% confidence interval [CI] = 11-13%) in Iowa to 20% (95% CI = 18-21%) in Alabama (Figure 2-2). When employing a more narrow case definition that measured “severe vision loss” as having “moderate difficulty” or worse, the prevalence ranged from 6% in West Virginia (95% CI = 5-7%) to 8% in Georgia (95% CI = 6-8%).

The prevalence of a “near vision” visual impairment also varied based upon the broadness of the definition. With the broad definition of visual impairment applied, the prevalence ranged from 27% in West Virginia (95% CI = 26-29%) to 39% in Georgia (95% CI = 37-41%). However, when the severe definition of visual impairment was applied, the prevalence ranged from 4% in Iowa (95% CI = 4-5%) to 8% in Georgia (95% CI = 7-9%). Prevalence of cataracts was highest in West Virginia (15%), while cataract removals were highest in Alabama (11%). The prevalence of glaucoma and macular degeneration was fairly steady at 4% to 5% across the states and prevalence of diabetic retinopathy only ranged from 1% (Iowa) to 2% (Georgia). The self-reported prevalence of workplace eye injury ranged from 7% (Georgia) to 13% (West Virginia) among the four
Visual Impairment Prevalence by Definition for State

![Graph showing prevalence by state and definition of visual impairment](image)

Note. Any Distance = any reported difficulty recognizing a friend across the street
Mod/Sev Distance = only moderate and extreme difficulty recognizing a friend across the street
Any Near = any reported difficulty in reading tasks
Mod/Sev Near = only moderate and extreme difficulty with reading tasks

Figure 2-2. Visual Impairment Prevalence by Definition for State

states. With the exception of diabetic retinopathy and workplace eye injury, women had a higher prevalence of visual impairment and eye disease/injury than men (see Figure 2-3 for prevalence based on definition of visual impairment).

Among age groups, prevalence of cataract, glaucoma, and macular degeneration increased with age, and prevalence of workplace eye injury decreased with age. Among all categories of visual impairment and eye disease/injury, prevalence decreased as level of education and level of income increased (see Figures 2-4 and 2-5, respectively, for prevalence based on definition of visual impairment). Prevalence varied by racial group, with blacks reporting the highest prevalence of distance and near vision impairments (18%, 38%, respectively) and whites reporting the fewest visual impairments (13% distance, 30% near) (see Figure 2-6). Whites reported the highest prevalence of cataracts (13%) and also reported having had the cataracts removed most frequently (11%).
Figure 2-3. Visual Impairment Prevalence by Definition for Gender

Note. Any Distance = any reported difficulty recognizing a friend across the street
Mod/Sev Distance = only moderate and extreme difficulty recognizing a friend across the street
Any Near = any reported difficulty in reading tasks
Mod/Sev Near = only moderate and extreme difficulty with reading tasks

Figure 2-4. Visual Impairment Prevalence by Definition for Education Level

Note. Any Distance = any reported difficulty recognizing a friend across the street
Mod/Sev Distance = only moderate and extreme difficulty recognizing a friend across the street
Any Near = any reported difficulty in reading tasks
Mod/Sev Near = only moderate and extreme difficulty with reading tasks
Note. Any Distance = any reported difficulty recognizing a friend across the street
Mod/Sev Distance = only moderate and extreme difficulty recognizing a friend across the street
Any Near = any reported difficulty in reading tasks
Mod/Sev Near = only moderate and extreme difficulty with reading tasks

Figure 2-5. Visual Impairment Prevalence by Definition for Income

Note. Any Distance = any reported difficulty recognizing a friend across the street
Mod/Sev Distance = only moderate and extreme difficulty recognizing a friend across the street
Any Near = any reported difficulty in reading tasks
Mod/Sev Near = only moderate and extreme difficulty with reading tasks

Figure 2-6. Visual Impairment Prevalence by Definition for Race/Ethnicity
Hispanics reported the lowest prevalence of cataracts (10%), and blacks reported having had cataracts removed least frequently (6%). Blacks and Hispanics reported the highest rate of diabetic retinopathy (3% for each group). Blacks reported the fewest workplace eye injuries (6%) and macular degeneration (3%), while those in the “other” racial category reported the highest rates of workplace eye injury (12%) and macular degeneration (5%) (Table 2-1).

Having eye-care insurance and use of eye care also varied among the four states (Table 2-1). The percentage of participants reporting no eye-care insurance ranged from 44% in Georgia to 50% in Iowa. In addition, the percentage reporting they had not had a dilated eye examination during the preceding 12 months ranged from 47% in Alabama to 51% in Georgia; the percentage reporting no visit to an eye-care professional in the preceding 12 months ranged from 25% in Iowa to 32% in West Virginia. Persons in the four states cited “no reason to go” (range: 42% in Georgia to 59% in Iowa) and “cost/insurance” (range: 19% in Iowa to 30% in West Virginia) as the most common reasons for not having visited an eye-care professional in the preceding 12 months.

Overall, persons aged 40-49 years old were most likely to report having eye-care insurance. The percentage of persons who had not had a dilated eye examination or a visit to an eye-care professional in the preceding 12 months decreased with increasing age. Men were more likely than women to report not having had a dilated eye examination.

Having eye-care insurance and use of eye care also varied by race/ethnicity, education, and income. Hispanics most often reported that they did not have eye insurance (52%), while blacks reported not having insurance least often (36%). Blacks also reported least often that they “had not visited their eye-care professional in the
Table 2-1

Prevalence of Self-reported, Selected Eye Diseases, and Workplace Eye Injury History Among Persons Aged ≥40 Years, by State and Selected Demographic Characteristics

<table>
<thead>
<tr>
<th>State/Characteristic</th>
<th>Cataract % (95% CI)</th>
<th>Cataracts Removed % (95% CI)</th>
<th>Glaucoma % (95% CI)</th>
<th>Macular Degeneration % (95% CI)</th>
<th>Diabetic Retinopathy % (95% CI)</th>
<th>Workplace Eye Injury % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>14.5 (13.3-15.7)</td>
<td>11.0 (10.0-12.0)</td>
<td>4.5 (3.9-5.1)</td>
<td>4.1 (3.5-4.8)</td>
<td>2.3 (1.9-2.7)</td>
<td>8.9 (7.9-10.1)</td>
</tr>
<tr>
<td>Georgia</td>
<td>11.4 (10.6-12.4)</td>
<td>8.4 (7.6-9.2)</td>
<td>3.7 (3.1-4.3)</td>
<td>4.5 (3.9-5.3)</td>
<td>2.1 (1.7-2.5)</td>
<td>7.1 (6.2-8.1)</td>
</tr>
<tr>
<td>Iowa</td>
<td>14.7 (13.6-15.8)</td>
<td>10.2 (9.3-11.2)</td>
<td>4.1 (3.5-4.8)</td>
<td>4.2 (3.6-4.9)</td>
<td>1.4 (1.1-1.8)</td>
<td>9.9 (8.8-11.1)</td>
</tr>
<tr>
<td>W. Virginia</td>
<td>15.1 (13.8-16.3)</td>
<td>9.7 (8.7-10.8)</td>
<td>4.8 (4.1-5.6)</td>
<td>4.1 (3.5-4.8)</td>
<td>2.0 (1.6-2.4)</td>
<td>12.7 (11.4-14.1)</td>
</tr>
<tr>
<td>Age (yrs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>1.7 (1.3-2.2)</td>
<td>2.4 (21.7-3.2)</td>
<td>1.5 (1.0-2.1)</td>
<td>2.3 (1.7-3.1)</td>
<td>1.3 (0.9-1.8)</td>
<td>9.8 (8.6-11.1)</td>
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<tr>
<td>50-59</td>
<td>8.6 (7.7-9.6)</td>
<td>3.4 (2.8-4.0)</td>
<td>3.0 (2.5-3.6)</td>
<td>3.5 (2.8-4.3)</td>
<td>3.1 (2.6-3.8)</td>
<td>9.5 (8.5-10.6)</td>
</tr>
<tr>
<td>60-69</td>
<td>23.5 (22.0-25.1)</td>
<td>8.6 (7.6-9.6)</td>
<td>4.7 (4.0-5.5)</td>
<td>4.8 (4.1-5.7)</td>
<td>4.8 (4.1-5.7)</td>
<td>9.2 (8.1-10.3)</td>
</tr>
<tr>
<td>70-79</td>
<td>33.7 (31.6-35.8)</td>
<td>26.3 (24.4-28.2)</td>
<td>8.3 (7.1-9.7)</td>
<td>7.3 (6.2-8.5)</td>
<td>3.9 (3.1-5.0)</td>
<td>5.7 (4.8-6.8)</td>
</tr>
<tr>
<td>≥80</td>
<td>24.4 (21.8-27.1)</td>
<td>46.7 (43.6-49.9)</td>
<td>12.6 (10.7-14.8)</td>
<td>16.1 (14.0-18.5)</td>
<td>3.1 (2.2-4.3)</td>
<td>3.8 (2.8-5.1)</td>
</tr>
<tr>
<td>≤65</td>
<td>7.0 (6.5-7.6)</td>
<td>3.5 (3.0-3.9)</td>
<td>2.4 (2.1-2.8)</td>
<td>2.8 (2.4-3.3)</td>
<td>1.6 (1.4-1.8)</td>
<td>9.7 (9.0-10.4)</td>
</tr>
<tr>
<td>≥65</td>
<td>30.1 (28.8-31.5)</td>
<td>26.1 (24.8-27.4)</td>
<td>8.6 (7.8-9.5)</td>
<td>8.4 (7.6-9.2)</td>
<td>4.2 (3.6-4.9)</td>
<td>5.8 (5.1-6.5)</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10.4 (9.6-11.3)</td>
<td>7.7 (7.0-8.5)</td>
<td>3.5 (3.0-4.0)</td>
<td>3.3 (2.8-3.8)</td>
<td>2.0 (1.7-2.4)</td>
<td>15.2 (14.1-16.4)</td>
</tr>
<tr>
<td>Female</td>
<td>15.5 (14.8-16.3)</td>
<td>11.0 (10.3-11.7)</td>
<td>4.6 (4.1-5.1)</td>
<td>5.2 (4.7-5.8)</td>
<td>2.0 (1.7-2.3)</td>
<td>3.0 (2.6-3.4)</td>
</tr>
<tr>
<td>Race/Ethn.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White only</td>
<td>13.1 (12.6-13.6)</td>
<td>10.7 (10.3-11.2)</td>
<td>4.4 (4.1-4.7)</td>
<td>4.6 (4.3-5.0)</td>
<td>1.7 (1.5-1.9)</td>
<td>8.7 (8.2-9.2)</td>
</tr>
<tr>
<td>Black only</td>
<td>10.9 (9.6-12.3)</td>
<td>6.0 (5.1-7.0)</td>
<td>8.0 (6.8-9.2)</td>
<td>2.9 (2.3-3.7)</td>
<td>3.2 (2.5-4.0)</td>
<td>5.5 (4.4-6.9)</td>
</tr>
<tr>
<td>Other</td>
<td>11.3 (9.2-13.8)</td>
<td>6.8 (5.1-8.9)</td>
<td>5.0 (3.5-7.2)</td>
<td>4.8 (3.4-6.6)</td>
<td>1.6 (0.8-4.8)</td>
<td>11.5 (8.8-14.9)</td>
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<tr>
<td>Hispanic</td>
<td>9.7 (8.2-11.3)</td>
<td>6.9 (5.7-8.2)</td>
<td>5.4 (4.2-6.9)</td>
<td>4.7 (3.4-6.8)</td>
<td>3.1 (1.7-5.7)</td>
<td>6.9 (5.5-8.8)</td>
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<td>Education</td>
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<td></td>
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<tr>
<td>&lt; high sch.</td>
<td>19.0 (17.1-21.0)</td>
<td>16.0 (14.3-27.8)</td>
<td>6.5 (5.3-7.8)</td>
<td>5.0 (4.0-6.1)</td>
<td>4.7 (3.9-5.7)</td>
<td>12.3 (10.5-14.3)</td>
</tr>
<tr>
<td>high sch.</td>
<td>14.5 (13.5-15.6)</td>
<td>10.3 (9.7-11.2)</td>
<td>4.9 (4.2-5.6)</td>
<td>4.6 (3.9-5.4)</td>
<td>2.5 (2.1-3.0)</td>
<td>10.8 (9.7-11.9)</td>
</tr>
<tr>
<td>&gt; high sch.</td>
<td>11.1 (10.4-11.8)</td>
<td>7.6 (6.9-8.3)</td>
<td>3.1 (2.7-3.5)</td>
<td>4.0 (3.5-4.5)</td>
<td>1.2 (1.0-1.4)</td>
<td>6.7 (6.0-7.4)</td>
</tr>
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<td>Annual Income</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15K</td>
<td>17.3 (15.4-19.4)</td>
<td>13.5 (12.0-15.3)</td>
<td>6.4 (5.2-7.9)</td>
<td>6.7 (5.3-8.4)</td>
<td>4.5 (3.6-5.6)</td>
<td>11.1 (9.3-13.2)</td>
</tr>
<tr>
<td>15-24.9K</td>
<td>17.3 (15.6-19.2)</td>
<td>12.8 (11.4-14.3)</td>
<td>7.0 (5.7-8.6)</td>
<td>6.3 (4.9-8.0)</td>
<td>3.7 (2.9-4.7)</td>
<td>10.6 (9.1-12.3)</td>
</tr>
<tr>
<td>25-34.9K</td>
<td>16.8 (15.0-18.8)</td>
<td>11.6 (9.8-13.7)</td>
<td>4.5 (3.5-5.6)</td>
<td>4.7 (3.7-5.9)</td>
<td>2.4 (1.7-3.3)</td>
<td>9.8 (8.2-11.7)</td>
</tr>
<tr>
<td>35-49.9K</td>
<td>12.7 (11.2-14.3)</td>
<td>7.7 (6.5-9.2)</td>
<td>3.1 (2.4-3.9)</td>
<td>3.6 (2.9-4.5)</td>
<td>0.9 (0.6-1.3)</td>
<td>9.8 (8.1-11.8)</td>
</tr>
<tr>
<td>≥50K</td>
<td>8.1 (7.4-8.9)</td>
<td>5.0 (4.4-5.7)</td>
<td>2.2 (1.8-2.6)</td>
<td>3.0 (2.5-3.7)</td>
<td>1.3 (0.9-2.0)</td>
<td>7.2 (6.4-8.1)</td>
</tr>
</tbody>
</table>

Note. These are the weighted results accounting for complex survey design.
previous 12 months" (35%) and "had not received a dilated eye exam" in the same time frame (48%). Respondents with less than a high school education or annual household income of less than $15,000 were least likely to have eye insurance (56%) and least likely to have visited an eye-care professional in the past year (35%). Moreover, the percentage without eye-care insurance decreased as education and income levels increased (see Table 2-2).

Discussion

This report is only the second to provide state-specific estimates of the self-reported prevalence of visual impairment, eye disease, and use of eye-care services. As previous research has demonstrated, prevalence rates varied among states, by age, race/ethnicity, education, and income (Bailey et al., 2006). There were two key differences between this study and the 2006 study conducted by Bailey et al., however. First, Bailey et al. included a case definition for self-reported visual impairment that encompassed any reported difficulty performing either the distance or near visual tasks. Since this study was exploratory, investigators chose to look at the near and distance impairments separately and also to examine any differences observed based upon severity of the impairment. This study also differed from Bailey et al.'s study in the case definition of cataracts. Bailey et al. defined "having cataracts" as anyone who reported currently having cataracts or reported ever having had cataracts removed. Investigators in this current study defined "having cataracts" only as those who currently have cataracts, and reported those who had cataracts removed in a separate category.
Table 2-2

Prevalence of No Eye-Care Insurance, No Dilated Eye Examination, and No Visit to an Eye-Care Professional Among Persons Aged ≥40 years, by State and Selected Demographic Characteristics

<table>
<thead>
<tr>
<th>State/Characteristic</th>
<th>No eye-care insurance % (95% CI)</th>
<th>No dilated eye exam % (95% CI)</th>
<th>No visit to eye profess % (95% CI)</th>
<th>Reason for no eye-care visit % (95% CI)</th>
<th>Cost/insurance % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>44.8 (43.0-46.6)</td>
<td>46.9 (44.9-48.9)</td>
<td>31.1 (27.3-35.1)</td>
<td>52.1 (49.2-55.1)</td>
<td>20.7 (18.5-23.1)</td>
</tr>
<tr>
<td>Georgia</td>
<td>43.1 (41.9-45.5)</td>
<td>50.6 (48.6-52.6)</td>
<td>25.6 (22.2-29.4)</td>
<td>42.2 (39.4-45.2)</td>
<td>23.1 (20.7-25.7)</td>
</tr>
<tr>
<td>Iowa</td>
<td>49.9 (44.1-47.6)</td>
<td>47.2 (45.3-49.0)</td>
<td>25.0 (20.8-29.6)</td>
<td>59.0 (56.0-62.0)</td>
<td>18.6 (16.4-21.1)</td>
</tr>
<tr>
<td>W. Virginia</td>
<td>48.2 (46.3-50.0)</td>
<td>50.2 (48.1-52.3)</td>
<td>31.9 (27.7-36.4)</td>
<td>50.9 (47.9-54.0)</td>
<td>30.4 (27.6-33.4)</td>
</tr>
<tr>
<td>Age (yrs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>40.2 (38.1-42.4)</td>
<td>58.2 (55.8-60.4)</td>
<td>38.1 (30.7-46.1)</td>
<td>46.9 (43.7-50.1)</td>
<td>24.9 (22.2-27.7)</td>
</tr>
<tr>
<td>50-59</td>
<td>43.3 (41.5-45.1)</td>
<td>51.8 (49.8-53.8)</td>
<td>32.9 (28.5-37.5)</td>
<td>44.2 (41.4-47.1)</td>
<td>26.8 (24.4-29.4)</td>
</tr>
<tr>
<td>60-69</td>
<td>49.9 (48.0-51.7)</td>
<td>43.0 (41.0-45.1)</td>
<td>28.8 (25.2-32.6)</td>
<td>51.0 (47.9-54.2)</td>
<td>19.9 (17.6-22.4)</td>
</tr>
<tr>
<td>70-79</td>
<td>50.3 (48.1-52.6)</td>
<td>32.9 (30.4-35.5)</td>
<td>17.5 (14.3-21.1)</td>
<td>58.5 (54.0-62.7)</td>
<td>8.5 (6.5-11.0)</td>
</tr>
<tr>
<td>≥80</td>
<td>49.5 (46.3-52.6)</td>
<td>26.3 (23.1-29.7)</td>
<td>16.2 (11.7-22.0)</td>
<td>66.5 (59.5-72.8)</td>
<td>6.6 (4.3-10.1)</td>
</tr>
<tr>
<td>≤64</td>
<td>42.8 (41.5-44.1)</td>
<td>54.1 (52.6-55.5)</td>
<td>32.3 (29.2-35.6)</td>
<td>46.0 (44.0-47.9)</td>
<td>25.2 (23.5-26.9)</td>
</tr>
<tr>
<td>&gt;65</td>
<td>50.4 (48.9-51.9)</td>
<td>33.4 (31.8-35.1)</td>
<td>15.7 (13.7-22.3)</td>
<td>58.7 (55.8-61.6)</td>
<td>11.3 (9.7-13.1)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>44.0 (42.3-45.7)</td>
<td>52.3 (50.4-54.2)</td>
<td>25.6 (22.4-29.1)</td>
<td>55.1 (52.3-57.8)</td>
<td>17.8 (15.7-20.1)</td>
</tr>
<tr>
<td>Female</td>
<td>45.5 (44.3-46.7)</td>
<td>46.2 (44.9-47.6)</td>
<td>25.7 (23.6-32.6)</td>
<td>41.7 (39.7-43.7)</td>
<td>27.4 (25.6-29.2)</td>
</tr>
<tr>
<td>Race/Ethn.</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>White only</td>
<td>43.3 (42.5-44.2)</td>
<td>48.3 (47.3-49.2)</td>
<td>36.0 (35.1-36.8)</td>
<td>51.4 (50.0-52.9)</td>
<td>20.4 (19.2-21.6)</td>
</tr>
<tr>
<td>Black only</td>
<td>45.8 (33.5-38.1)</td>
<td>48.2 (45.4-51.1)</td>
<td>35.1 (32.9-37.5)</td>
<td>43.1 (39.2-47.1)</td>
<td>25.2 (21.7-29.1)</td>
</tr>
<tr>
<td>Other</td>
<td>39.0 (34.9-43.4)</td>
<td>53.7 (48.9-58.4)</td>
<td>41.2 (37.0-45.6)</td>
<td>48.3 (41.3-55.4)</td>
<td>22.4 (17.5-28.3)</td>
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<tr>
<td>Hispanic</td>
<td>52.3 (49.3-55.3)</td>
<td>52.1 (48.8-55.4)</td>
<td>38.0 (35.2-40.8)</td>
<td>39.6 (35.3-44.1)</td>
<td>32.1 (28.1-36.4)</td>
</tr>
<tr>
<td>Education</td>
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<tr>
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<td>56.0 (53.2-58.9)</td>
<td>55.9 (52.6-59.2)</td>
<td>35.2 (30.1-40.7)</td>
<td>40.2 (35.8-44.8)</td>
<td>33.2 (29.3-37.3)</td>
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<tr>
<td>high sch.</td>
<td>48.1 (46.4-49.8)</td>
<td>51.4 (49.5-53.3)</td>
<td>25.9 (22.5-29.5)</td>
<td>48.4 (45.7-51.1)</td>
<td>24.3 (22.2-26.6)</td>
</tr>
<tr>
<td>&gt; high sch.</td>
<td>40.5 (39.1-41.9)</td>
<td>46.5 (44.9-48.1)</td>
<td>26.2 (23.0-29.6)</td>
<td>50.5 (48.0-53.0)</td>
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<td>Annual income</td>
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<td></td>
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<tr>
<td>&lt;15K</td>
<td>63.3 (60.2-66.2)</td>
<td>57.4 (53.7-61.1)</td>
<td>34.8 (29.2-40.8)</td>
<td>30.1 (25.9-34.8)</td>
<td>47.2 (42.5-51.9)</td>
</tr>
<tr>
<td>15-24.9K</td>
<td>58.5 (55.9-61.1)</td>
<td>53.7 (50.6-56.7)</td>
<td>25.3 (24.3-34.9)</td>
<td>36.8 (32.9-40.9)</td>
<td>38.4 (34.5-42.5)</td>
</tr>
<tr>
<td>25-34.9K</td>
<td>50.2 (47.1-53.2)</td>
<td>51.2 (47.8-54.6)</td>
<td>15.5 (14.7-25.5)</td>
<td>50.8 (45.6-56.1)</td>
<td>21.5 (17.8-25.7)</td>
</tr>
<tr>
<td>35-49.9K</td>
<td>45.1 (42.4-48.0)</td>
<td>49.2 (46.1-52.3)</td>
<td>28.9 (23.3-35.3)</td>
<td>53.2 (48.5-57.9)</td>
<td>20.2 (16.2-24.9)</td>
</tr>
<tr>
<td>≥50K</td>
<td>33.7 (32.1-35.3)</td>
<td>47.7 (45.8-49.6)</td>
<td>26.1 (22.1-30.7)</td>
<td>57.1 (54.0-60.0)</td>
<td>9.8 (8.1-11.8)</td>
</tr>
</tbody>
</table>

Note. These are the weighted results accounting for complex survey design.
It is also important to note that the states included in this study are not necessarily representative of the nation as a whole. Three of the four states are located in the South (Alabama, Georgia, and West Virginia) and one (Iowa) in the Midwest, all of which vary from the national average on one or more important variables explored in this study (see Table 2-3). All of the states included in this study are poorer than the national average, which could significantly impact access to eye care. Additionally, Iowa and West Virginia have a disproportionately large white population and also have higher rates of people older than 65 years, while Georgia and Alabama have disproportionately large populations of blacks and those with less than a high school education when compared to the national average. This suggests that there is a need for continued state-level surveillance of visual impairment and access to eye care since age, race, and education have been shown to be links to increases in eye disease but lower access to care (Bailey et al., 2006). These results also indicate a need to investigate potential eye-care access barriers and identify eye health disparities related to state-level factors as well as social determinants of health (i.e., education, income, access to insurance, demographic factors) so that underserved or at risk population can be targeted.

Approximately half of those who did not visit an eye-care professional during the preceding 12 months said that they had no reason to go. This result varied slightly by state but was very high for those in the oldest age category (80+ years old). While the group of people in the oldest age group who reported not going to their eye doctor was relatively small, nearly 7 out of 10 reported that there was “no need to go” despite recommendations by eye-care professionals to the contrary. Both the American Optometric Association and the American Academy of Ophthalmologists recommend
Table 2-3

Comparison of State-level Data to National Data for Age, Race, Income, and Education

<table>
<thead>
<tr>
<th></th>
<th>National Averages</th>
<th>Alabama</th>
<th>Georgia</th>
<th>Iowa</th>
<th>West Virginia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% ≥65 years</td>
<td>12.5</td>
<td>13.4</td>
<td>9.8</td>
<td>14.7</td>
<td>15.4</td>
</tr>
<tr>
<td><strong>Race (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>78.1</td>
<td>72.3</td>
<td>65.7</td>
<td>94.7</td>
<td>95.2</td>
</tr>
<tr>
<td>Black</td>
<td>11.7</td>
<td>25.0</td>
<td>28.3</td>
<td>02.1</td>
<td>03.1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>10.7</td>
<td>01.6</td>
<td>05.0</td>
<td>02.6</td>
<td>00.7</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean in dollars</td>
<td>68,000</td>
<td>55,000</td>
<td>65,000</td>
<td>58,000</td>
<td>48,000</td>
</tr>
<tr>
<td><strong>Education (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥high school</td>
<td>84.0</td>
<td>79.0</td>
<td>77.9</td>
<td>87.1</td>
<td>81.0</td>
</tr>
</tbody>
</table>

*Note.* American Community Survey (2008), Income rounded to the nearest $1,000.

Annual eye exams for persons with diabetes and also for those aged ≥ 65 years (American Academy of Ophthalmology, 2007; American Optometric Association, 2008). Since early symptoms of eye problems can appear asymptomatic, early detection and timely treatment can prevent visual impairment and progression of conditions leading to vision loss and blindness. Prevention and control of major eye conditions are available; yet, research shows that many people do not access these services (Zhang et al., 2008). However, in this study, approximately 33% of respondents aged ≥65 years had not had a dilated eye examination, and approximately 20% had not visited an eye-care professional during the preceding 12 months.

This report is subject to at least four limitations. First, data were collected by telephone survey and thus may not be representative of people who do not use the telephone, do not have a land line, have hearing impairments that impede oral
communication via the telephone, or have mobility impairments that impede their ability to get to the phone. Second, the data included in this study rely on self-reported visual impairment, eye diseases, and eye-care access and use; therefore, information may not be as accurate as clinical reports and may be influenced by the respondents’ interpretation of the questions based on the general health-related topic of the survey generally. Research has shown that respondents may view their vision limitation as less serious, given other topics in a health related survey (Kirchner, 1999; Todorov, 1999). Third, there is currently no standard case definition by which to classify “visual impairment.” This study examined distance and near impairments separately since it was an exploratory study. Therefore, it is unclear if the people reporting difficulty seeing at a distance (recognizing a friend across the street) are also reporting difficulty seeing for near tasks (reading a newspaper); therefore, the overall prevalence of people with any difficulty seeing might, in fact, be larger than is reported here. However, it is noteworthy that those reporting difficulty with near tasks reported visiting their eye-care professional more frequently than those reporting a distance limitation. Finally, the BRFSS surveys only noninstitutionalized, civilian populations; therefore, these results may not generalize to those in nursing homes, prisons, the military, or other group quarters.

Based on these results, continued state-level surveillance is necessary to further assess prevalence of visual impairment and eye disease as well as access to eye care. Health policy advocates should consider including extensive eye-care coverage for Medicare and Medicaid beneficiaries to remove barriers to eye care for those most at risk for eye diseases and potentially limiting visual impairment. These data may serve as evidence of the need for vision-loss prevention and health promotion programs and may
provide benchmark data for program monitoring. They may also demonstrate areas of health disparity regarding eye health and access to care, and assist program planners and legislators in the allocation of scarce resources.

References


CHAPTER III

FACTORS PREDICTING EYE CARE ACCESS AMONG OLDER AMERICANS

Background/Significance

In recent years, eye diseases and visual impairments have been recognized by eye-care professionals and public health investigators as critical public health concerns (Crews & Campbell, 2004; Crews, Jones, & Kim, 2006; Lollar & Crews, 2003; Saaddine, Narayan, & Vinicor, 2003; Zhang et al., 2008). Eye diseases that lead to visual impairment affect an estimated 21.2 million Americans annually, according to a 2007 National Health Interview Survey (NHIS) (Pleis & Lethbridge-Cejku, 2007). That number is expected to increase over time, and perhaps unnecessarily so. Early detection and treatment of potentially harmful eye conditions are available, and yet recent research shows that access to eye care remains a significant problem (Freeland, Crews, Wall Emerson, & Fogarty, 2009; Zhang et al., 2008). Access to care is a multifaceted issue comprised of both individual factors (e.g., whether a person has the financial means to go to the doctor) and community factors (e.g., whether there are doctors in the area) (Zhang et al., 2008). The purpose of this study is to examine the factors that influence the use of eye care and predict non-use based on the presence of a visual impairment, eye disease/injury, vision loss, and social demographic circumstances. Specific factors explored include social demographics (age, gender, race/ethnicity, education, annual household income, possession of eye-care insurance), self-reported visual impairment,
and diagnosed eye disease. The combined effects of these factors were also examined. By understanding these factors, policy makers, program planners, and advocates for eye care can better target policies and interventions to promote eye-care access.

The Impact of Visual Impairment

Vision impairment has been identified by investigators at the Centers for Disease Control and Prevention as a significant public health concern (Crews & Campbell, 2004; Crews et al., 2006; Lollar & Crews, 2003). A number of studies have demonstrated the association between visual loss and other health conditions, including higher rates of hip fracture (Cummings et al., 1995; Felson et al., 1989), poor nutrition (Tumosa, 2008), depression (Brody et al., 2001; Rovner & Ganguli, 1998), medication errors (Tumosa, 2008), cognitive deterioration (Lin et al., 2004), arthritis (Nevitt, Cummings, Kidd, & Black, 1989), infection (Tumosa, 2008), falls (Dunlop et al., 2005; Tumosa, 2008), and mortality (Tumosa, 2008; Wang, Mitchell, Simpson, Cumming, & Smith, 2001). These associated events place people with visual impairments at increased risk of high healthcare utilization, increased need for rehabilitation, and diminished quality of life. While it is quite possible to live a healthy life with a visual impairment (American Foundation for the Blind, 2008), it is commonly considered by public health professionals that prevention of visual impairment when possible is beneficial to one’s overall health (Zhang et al., 2008).

Early detection and treatment is available for many common eye conditions that lead to visual impairment; however, access to those treatments remains a problem and the number of people affected by vision-threatening eye diseases continues to rise (Zhang et
It is estimated that between 2004 and 2020 the population of Americans with glaucoma will increase from 2.2 million to 3.3 million, age-related macular degeneration will increase from 1.8 million to 2.9 million, cataracts will increase from 20.5 million to 30.1 million, and diabetic retinopathy will increase from 4.1 million to 7.2 million (Age-Related Eye Disease Study Research Group, 2001; Eye Diseases Prevalence Research Group, 2004). The increasing prevalence of diabetes alone will likely influence rates of comorbid eye conditions of cataracts, diabetic retinopathy, and glaucoma; those who are older and from ethnic/racial minority groups are most likely to be at risk (Saaddine et al., 2008). Additionally, workplace eye injury is a growing concern (Peate, 2007), with approximately 700,000 new cases annually, 280,000 of which require medical attention (Xiang, Stallones, Chen, & Smith, 2005). Based on information gathered from the National Center on Injury Prevention and Control, investigators estimate that 10%-20% of all workplace injuries and illness cause vision loss, resulting in an estimated one million Americans currently experiencing vision loss due to a workplace event (Prevent Blindness America, 2008).

Primary and eye-care professionals recommend regular visits to eye-care providers as a part of a standard continuum of care (American Academy of Ophthalmology, 2007; American Optometric Association, 2008). The National Eye Institute recommends that people with eye diseases, those at high risk for disease due to family history or being in a high risk group, and everyone aged 60 years and older should receive annual eye examinations. It also advises people between the ages of 40 and 60 years old without current eye disease and not at high risk for disease to visit their eye-care professional biennially (National Eye Institute, 2009). However, a report by Bailey et al., (2006)
revealed that approximately 45% of BRFSS Visual Impairment and Access to Eye Care Module survey respondents in 2005 reported they had not received a dilated eye exam in the previous 12 months, and approximately 30% had not even visited an eye-care professional in the same time period. Potential reasons for this deficiency of eye-care access include personal factors such as a lack of health-related education and knowledge, demographics, or inability to pay for services; physical barriers to access such as a lack of transportation or available doctors in a given region; and policy barriers to access that result in a lack of insurance or payment options (Zhang et al., 2008). Additional factors that may also influence access to care are often referred to as determinants of health, or factors that, when combined together, affect the overall health of individuals as well as communities of people. Factors such as income level, education, genetics, where people live, and relationships with family and friends all have significant influences on health and can have a considerable impact on access use of health care services (World Health Organization [WHO], 2009). This complex interaction of variables can lead to disparities in health status resulting in health inequities.

Research indicates that people living with disabilities, specifically visual impairments, may be regarded as those who have historically experienced health disparity and healthcare inequity (Crews & Lollar, 2008). “Health disparity” is commonly defined in public health as a type of health difference that adversely affects groups of people who have systematically experienced discrimination or exclusion due to social or economic obstacles to health based on their race/ethnicity, socioeconomic status, gender, disability status (Carter-Pokras & Baquet, 2002; The Secretary’s Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020, 2008). Despite federal
policy prohibiting discrimination of people with disabilities in employment, public services, public accommodations, and telecommunications (The Americans with Disabilities Act of 1990), gaps in access still exist due in part to the complex nature of the experience of disability. The experience can be described as a multidimensional interaction between the physical expression of the disease causing the impairment, its impact on physical activity and social participation, and the environmental and personal factors that serve as barriers or facilitators to healthy living.

A conceptual framework that takes into account this multifactored experience and provides a structure by which to describe the impact of the disability is the International Classification of Functioning, Disability and Health (ICF). The ICF is the World Health Organization’s (WHO) framework for measuring health and disability at both individual, group, and population levels (WHO, 2008). It was endorsed by the 191 WHO member states in May 2001 (resolution WHA 54.21). The ICF is an integrated model meshing body functions and structures (anatomy/biology), health conditions (diseases or disorders), activities (performance of tasks) participation (involvement in life situations), and personal or environmental factors (Hendershot, Placek, & Goodman, 2006; International Classification of Functioning [ICF], 2008) (see Figure 3-1). The ICF model serves as framework on which to structure health-related assessment survey questions in order to gain insight into the conceptual clarity of the questions and is discussed in greater detail in previous papers (Freeland et al., 2009).

In order to identify possible health disparities for people living with visual impairments, research using health-related, population-based data targeting vision and vision health is vital. Previous research examining visual impairment and eye care in the
United States explored prevalence and utilization of eye care using the Behavioral Risk Factor Surveillance System (BRFSS) (Bailey et al., 2006). The BRFSS is a state-based system of health surveys collecting information about health care access and use, clinical preventive health practices, and health risk behaviors primarily related to injury and chronic disease. It consists of three parts: (a) the fixed core component is used by all states and gathers demographic information including age, sex, race/ethnicity, income, and education, as well as current behaviors that affect health (e.g., tobacco use, frequency of physical activity); (b) optional modules that include standardized questions about specific health-related topics (e.g., childhood asthma, cardiovascular health, sexual health); and (c) state add-on questions that may gather information about regional health concerns. The core survey consists of 83 questions, while the optional modules range
from only 4 questions to as many as 13, and the number of state add-on questions is left to state discretion. The BRFSS is a cross-sectional random-digit-dialed telephone survey conducted by state health departments with the Centers for Disease Control and Prevention providing financial, technical, and methodological assistance, as well as assistance in aggregating and distributing monthly data. Each state conducts the survey using standard “core” questions, as well as optional modules that are topic specific, all of which are standardized.

Two modules that are of interest to the field of vision are the Visual Impairment and Access to Eye Care Module and the Diabetes Module. The BRFSS Visual Impairment and Access to Eye Care Module includes 10 questions related to body functions and structures (e.g., eye diseases such as macular degeneration), the respondent’s ability to complete an activity (e.g., read the newspaper or recognize a friend from a distance), participation in life activities (e.g., visit their eye-care professional), and personal factors (e.g., age, sex, race). There is 1 question in the core survey related to diabetes (diagnosis of diabetes), and the Diabetes Module contains 12 additional questions regarding age of onset of the disease, the respondent’s current medication habits (i.e., insulin, pills); diabetes management habits (e.g., frequency of blood glucose and A1C monitoring, foot care, participation in diabetes education course); and eye health activities (e.g., dilated eye examination).

The purpose of the current study is to examine the factors that influence the use of eye care and predict non-use based on the presence of a visual impairment, eye disease/injury, vision loss, and social demographic circumstances. This investigation used aggregated data from the 2005, 2006, and 2007 administrations of the BRFSS Visual
Impairment and Access to Eye Care Module, with an additional response regarding diagnosed diabetic retinopathy taken from the Diabetes Module, to address two research questions. First, how do demographic variables such as age, gender, race/ethnicity, education, annual household income, visual impairment, eye disease, and having eye insurance influence eye doctor visits? And second, are there any significant interactions between variables that help to predict non-use of eye care?

Methods

Study Design

The BRFSS Visual Impairment and Access to Eye Care Module is a state-based, random-digit-dialed telephone survey of the noninstitutionalized, U. S. civilian population aged ≥40 years. Investigators in the current study conducted a secondary data analysis of aggregated data from the 2005, 2006, and 2007 BRFSS Visual Impairment and Access to Eye Care and Diabetes Modules in order to examine the predictive relationships between demographic variables (age, sex, race/ethnicity, education, and annual family income); self-reported visual impairment (VI); specific eye disease/injury (macular degeneration, cataracts, diabetic retinopathy, workplace eye injuries) and eye care (eye-care insurance and reason for choosing to go to the eye-care professional); and whether the respondent visited his or her eye-care professional. States that completed both the Visual Impairment and Access to Eye Care Module and Diabetes Modules in 2005, 2006 and 2007 were Alabama, Arizona, Florida, Georgia, Iowa, Louisiana, New York, Ohio, Tennessee, Texas, and West Virginia. Participants were included in the study
if they answered questions in the BRFSS Visual Impairment and Access to Eye Care Module and the diabetic retinopathy question from the Diabetes Module of the same year. For states that implemented the modules in more than one year, the most recent implementation year was used in the analyses. The data were obtained from telephone interviews with 40,665 people completing all or a portion of the BRFSS Visual Impairment and Access to Eye Care and Diabetes Modules in 2005, 2006, and 2007.

Measures

Demographic information (age, sex, race/ethnicity, level of education, and household income) were taken from the BRFSS core survey. The continuous variable for age was coded to reflect age categories by decades; sex was recorded as either male or female; level of education was coded to reflect “less than high school,” “high school,” and “more than high school”; and household income was coded to reflect the categories: <$15,000, $15,000-24,999, $25,000-34,999, $35,000-49,999, and >$50,000 (see Box 3-1). All respondents aged ≥40 were given the BRFSS Visual Impairment and Access to Eye Care Module for the states that chose to implement that module for a given year. The current study used all responses in the BRFSS Visual Impairment and Access to Eye Care Module and also included a question about the presence of diabetic retinopathy taken from the Diabetes Module in 2005, 2006, and 2007. Since the data were pooled, questions and responses from 2005, 2006, and 2007 were compared to ensure comparability across years. Questions not replicated in all 3 years were not used in this study. Missing and nonresponses were excluded from analyses.
**BRFSS Core Questions Used:**

12.1 What is your age? (Continuous variable)

12.2 Are you Hispanic or Latino? Yes/no

12.3 Which one or more of the following would you say is your race?
   - White
   - Black or African-American
   - Asian
   - Native American or Other Pacific Islander
   - Other [specify]
   - No additional choices
   - Don't know

12.8 What is the highest grade or year of school you completed?
   - Never attended school or only attended kindergarten
   - Grades 1-8 (elementary)
   - Grades 9-11 (some high school)
   - Grade 12 or GED (high school)
   - College 1 year to 3 years (some college or technical school)
   - College 4 years or more (college graduate)

12.10 Is your annual household income from all sources—
   - Less than $10,000
   - Less than $15,000
   - Less than $20,000
   - Less than $25,000
   - Less than $35,000
   - Less than $50,000
   - Less than $75,000
   - $75,000 or more

12.20 Indicate sex of respondent: male/female

---

**Box 3-1. BRFSS Core Questions Used**

Respondents were classified as having a distance visual impairment if they answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to the question “How much difficulty, if any, do you have in
recognizing a friend across the street?” (BRFSS, 2007, p. 38; BRFSS, 2008a, p. 42; BRFSS, 2008b, p. 37). Participants were classified as having a near visual impairment if they answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to the question “How much difficulty, if any, do you have in reading print in newspaper, magazine, recipe, menu, or numbers on the telephone?” (BRFSS, 2007, p. 38; BRFSS, 2008a, p. 42; BRFSS, 2008b, p. 37) (see Box 3-2). A person with a cataract was identified by a positive response to the question, “Have you been told by an eye doctor or other health care professional that you NOW have cataracts?” A person with glaucoma was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?” A person with macular degeneration was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?” A person with a workplace eye injury was identified by a positive response to the question, “Have you EVER had an eye injury that occurred at your workplace while you were doing your work?” (see Box 3-2). A person with diabetic retinopathy was identified from the BRFSS Diabetes Module if a respondent answered “yes” to the question, “Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?” (BRFSS, 2007, p. 36; BRFSS, 2008a, p. 41; BRFSS, 2008b, p. 36).

Eye doctor visits were identified by responses to the question: “When was the last time you visited any eye-care professional?” Responses were coded to reflect whether the respondent had visited his or her eye-care professional in the previous 12 months. Access to eye care was further explored using the question: “Do you have any kind of health
BRFSS Visual Impairment and Access to Eye Care Module Questions Used:

1. How much difficulty, if any, do you have in recognizing a friend across the street? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don’t know
   h. Not applicable (blind)
   i. Refused

2. How much difficulty, if any, do you have reading print in a newspaper, magazine, recipe, menu, or numbers on the telephone? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don’t know
   h. Not applicable (blind)
   i. Refused

3. When was the last time you had your eyes examined by any doctor or eye care provider?
   a. Within the past month
   b. Within the past year
   c. Within the past 2 years
   d. 2 or more years ago
   e. Never
   f. Don’t know
   g. Not applicable (blind)
   h. Refused

4. What is the main reason you have not visited an eye care professional in the past 12 months?
   a. Cost/insurance
   b. Do not have/know an eye doctor
   c. Cannot get to the office/clinic (too far away, no transportation)
   d. Could not get an appointment
   e. No reason to go (no problem)
   f. Have not thought of it
   g. Other
   h. Don’t know
   i. Not applicable (blind)
   j. Refused

(continued on next page)
5. When was the last time you had an eye exam in which your pupils were dilated? This would have made you temporarily sensitive to bright light.
   a. Within the past month
   b. within the past year
   c. Within the past 2 years
   d. 2 or more years ago
   e. Never
   f. Not applicable (blind)

6. Do you have any kind of health insurance coverage for eye care?
   a. Yes
   b. No
   c. Not applicable (blind)

7. Have you been told by an eye doctor or other health care professional that you NOW have cataracts?
   a. Yes
   b. Yes, but had them removed
   c. No
   d. Not applicable (blind)

8. Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?
   a. Yes
   b. No
   c. Not applicable (blind)

Age-related Macular Degeneration (AMD) is a disease that blurs the sharp, central vision you need for “straight ahead” activities such as reading, sewing, and driving. AMD affects the macula, the part of the eye that allows you to see fine detail.

9. Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?
   a. Yes
   b. No
   c. Not applicable (blind)

10. Have you EVER had an eye injury that occurred at your workplace while you were doing your work?
    a. Yes
    b. No

Box 3-2. BRFSS Visual Impairment and Access to Eye Care Module Questions Used (continued):

insurance coverage for eye care?” (BRFSS, 2007, pp. 39-41; BRFSS, 2008a, pp. 43-46; BRFSS, 2008b, pp. 37-40) (see Box 3-2).
Data Analysis

Data were analyzed using the SPSS version 16.0 Complex Samples Module to account for the multistage, complex survey design methods (SPSS, 2007). Stratification and weights were used and standard errors were adjusted using stratum information provided in the data (BRFSS, 2008b). Diagnostic tests were conducted to explore bivariate relationships between predictor variables to assess for possible confounding. Investigators determined that there were no statistically significant correlations between predictor variables (age, gender, race/ethnicity, education, annual income, visual impairment [VI], eye disease/injury, and possession of eye-care insurance); thus, all predictor variables were included in analyses. Forced entry (direct) binary logistic regression was used to explore the predictive relationship between demographic, VI, and eye-care variables and whether participants went to the eye-care professional in the previous 12 months (yes/no). The forced entry method enters the predictor variables into the model at the same time and in no particular order. This method was used since there was no preconceived idea of the order of influence of the variables included in the model.

Predictor variables included in these analyses were VI (presence of distance and near visual impairment), eye diseases/injury (macular degeneration, cataracts, diabetic retinopathy, and workplace eye injury), and possession of eye-care insurance, while accounting for age, gender race/ethnicity, education level, and income. The outcome variable in this study was whether the respondent visited their eye-care professional in the previous 12 months (yes/no). Main effects were examined. Additionally, all statistically
significant main effects were combined in order to examine all two-way interaction
effects for those variables with the exception of multiple visual impairments.eye diseases.

Results

The analyses involved valid data for 48,007 subjects across the 3 years of data
(n = 1,376 for 2005, n = 27,879 for 2006, and n = 18,752 for 2007) (see Tables 3-1 and
3-2). Descriptive analyses were run to describe the groups of people who had visited their
eye doctor in the previous 12 months and those who had not. Results indicated that
among people who did not have eye insurance, 44% did not visit their eye doctor in the
previous 12 months, compared to only 30% of those who did have insurance. For both
groups, nearly a quarter of those people who did not visit their eye doctor blamed cost as
the factor, while half of them claimed to have “no reason to go” (49%).

Non-use of care decreased as age increased, with only 3% of those in the oldest
age group (≥80 years) reporting that they did not visit their eye doctor, compared with
45% of people in the youngest age group (40-49 years). When age was divided into two
groups (≤64 years and ≥65 years), the younger group reported non-use of eye care at a
rate of 42% compared to only 24% in the older age group. Of the people who did not go
to their eye doctor in the previous 12 months, whites reported non-use most frequently
(74%), while blacks, Hispanics, and all others reported non-use much less frequently
(10%, 11%, and 6%, respectively). It should be noted, however, that, overall, people in
the “other” racial group (American Indians, Asians, Pacific Islanders, and Alaska
Natives) reported non-use most frequently (41%) and blacks reported non-use least often
(35%). Non-use in the previous 12 months varied slightly by income, ranging from 16%
(≤$15,000 per year) to 24% ($15,000-24,900 per year). Doctor visits decreased as education increased, with those having less than a high school education reporting "no doctor visit" only 14% of the time compared to those with more than a high school education.

Table 3-1

Demographic Make-up of the Sample of Persons Aged ≥40 Years

<table>
<thead>
<tr>
<th>Demographics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24,211</td>
<td>36.5</td>
</tr>
<tr>
<td>Female</td>
<td>42,124</td>
<td>63.5</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>12,114</td>
<td>23.9</td>
</tr>
<tr>
<td>50-59</td>
<td>13,903</td>
<td>27.4</td>
</tr>
<tr>
<td>60-69</td>
<td>11,631</td>
<td>22.9</td>
</tr>
<tr>
<td>70-79</td>
<td>8,647</td>
<td>17.1</td>
</tr>
<tr>
<td>80+</td>
<td>4,404</td>
<td>08.7</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>49,811</td>
<td>75.8</td>
</tr>
<tr>
<td>Black</td>
<td>8,056</td>
<td>12.3</td>
</tr>
<tr>
<td>Other</td>
<td>2,432</td>
<td>03.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5,376</td>
<td>08.2</td>
</tr>
<tr>
<td>Education level</td>
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<td></td>
</tr>
<tr>
<td>&lt;High school</td>
<td>8,399</td>
<td>12.7</td>
</tr>
<tr>
<td>High school</td>
<td>21,042</td>
<td>31.8</td>
</tr>
<tr>
<td>&gt;High school</td>
<td>36,685</td>
<td>55.5</td>
</tr>
<tr>
<td>Household income</td>
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<td></td>
</tr>
<tr>
<td>≤$15,000</td>
<td>7,442</td>
<td>11.2</td>
</tr>
<tr>
<td>$15,000-24,999</td>
<td>10,773</td>
<td>16.2</td>
</tr>
<tr>
<td>$25,000-34,999</td>
<td>7,594</td>
<td>11.4</td>
</tr>
<tr>
<td>$35,000-49,999</td>
<td>9,025</td>
<td>13.6</td>
</tr>
<tr>
<td>≥$50,000</td>
<td>9,100</td>
<td>13.7</td>
</tr>
<tr>
<td>Eye care insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24,960</td>
<td>52.9</td>
</tr>
<tr>
<td>No</td>
<td>22,238</td>
<td>47.1</td>
</tr>
</tbody>
</table>

Note. Results displayed are unweighted and thus reflect the raw sample size.
Table 3-2

Visual Impairment, Eye Disease, and Eye Care Among the Sample

<table>
<thead>
<tr>
<th>Vision Health</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Visual Impairment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7,594</td>
<td>11.4</td>
</tr>
<tr>
<td>No</td>
<td>40,541</td>
<td>61.1</td>
</tr>
<tr>
<td>Near Visual Impairment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15,322</td>
<td>23.1</td>
</tr>
<tr>
<td>No</td>
<td>32,857</td>
<td>49.5</td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,586</td>
<td>02.4</td>
</tr>
<tr>
<td>No</td>
<td>64,749</td>
<td>97.6</td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7,687</td>
<td>11.6</td>
</tr>
<tr>
<td>No</td>
<td>34,484</td>
<td>52.0</td>
</tr>
<tr>
<td>Glaucoma</td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2,643</td>
<td>05.5</td>
</tr>
<tr>
<td>No</td>
<td>45,345</td>
<td>94.5</td>
</tr>
<tr>
<td>Macular Degeneration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>45,352</td>
<td>04.9</td>
</tr>
<tr>
<td>No</td>
<td>2,347</td>
<td>95.1</td>
</tr>
<tr>
<td>Workplace eye injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3,566</td>
<td>05.4</td>
</tr>
<tr>
<td>No</td>
<td>44,524</td>
<td>67.1</td>
</tr>
<tr>
<td>Eye care insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24,960</td>
<td>52.9</td>
</tr>
<tr>
<td>No</td>
<td>22,238</td>
<td>47.1</td>
</tr>
<tr>
<td>Eye care in the past 12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>31,317</td>
<td>47.2</td>
</tr>
<tr>
<td>No</td>
<td>16,690</td>
<td>25.2</td>
</tr>
</tbody>
</table>

Note. Results displayed are unweighted and thus reflect the raw sample size.

education reporting “no doctor visit” 56% of the time. Variations in non-use of eye care were also discovered for people who had reported a diagnosed eye diseases/injury.
Sixteen percent of those with cataracts, 18% of those with diabetic retinopathy, 11% of those with glaucoma, 19% of those with macular degeneration, and 45% of those with workplace eye injuries reported that they had not visited their eye doctor in the previous 12 months.

Binary logistic regression analyses were conducted to explore the predictive relationships between demographic variables (age, gender, race/ethnicity, education, and income), possession of eye insurance, self-reported visual impairment (for distance and near tasks), diagnosed eye diseases/injury, and their impact on whether people visit their eye doctor. Diagnostic tests were conducted to explore bivariate relationships between predictor variables in order to assess for potential confounding. Assumptions were tested and met by assessing Variance Inflation Factor (collinearity) and by using cross-sectional data (independence of errors). Each model was further assessed for linearity using Hosmer and Lemeshow’s Goodness-of-fit test (Hosmer & Lemeshow, 1989). Nagelkerke’s Pseudo $R^2$, a test appropriate for binary logistic regression models, was used to determine the amount of variance explained by each model (Nagelkerke, 1991).

The first binary logistic regression model examined the main effects of all predictor variables. Included in this model were self-reported visual impairment (distance and near), cataracts, glaucoma, macular degeneration, diabetic retinopathy, workplace eye injury, and possession of eye-care health insurance while accounting for gender, age, race/ethnicity, education, and household income. The Hosmer and Lemeshow Goodness-of-fit test showed that this model was a good fit to the data since there was not a statistically significant difference between the model prediction and observed values ($p = 0.15$). This model accounted for 14.4% of the variance in non-use of eye care.
(Nagelkerke's Pseudo $R^2 = 0.150$). Distance visual impairment ($p = .92$) and workplace eye injury ($p = 0.30$) were not statistically significant predictors in this model ($\alpha = 0.05$, $p < .00$); therefore, "distance visual impairment" and "workplace eye injury" were removed from the model and analyses were conducted again. The new model still accounted for only 14.9% of the variance (Nagelkerke's Pseudo $R^2 = 0.149$). This analysis revealed a strong statistically significant difference in eye-care visits based upon a difficulty with near tasks (i.e., reading a newspaper), diagnosed cataracts, glaucoma, macular degeneration, and diabetic retinopathy (see Table 3-3). Additionally, all social demographic variables (sex, age, race/ethnicity, education, possession of insurance, and income) were also statistically significant predictors of eye-care use (see Table 3-4).

These variables had an overall accuracy level of 66% (accounting for prediction accuracy for both use and non-use of eye care); however, they were more accurate in predicting who would use eye care (80%) than who would not use eye care (45%), since some of the people that the model predicted would not go to their eye-care professional actually went. These results revealed that people who do not have cataracts, glaucoma, macular degeneration, and diabetic retinopathy are as much as 3 times less likely to visit their eye-care professional than those who have the disease. Similarly, these results reveal that people under 60 years old were as much as 2.5 times less likely to visit their eye doctor than people over 60 years old when compared with people aged 80 years and older. People without insurance and those making less than $25,000 per year were as much as 2 times less likely to visit their eye doctor when compared with those with insurance and those making more than $50,000 per year (see Table 3-4).
Table 3-3


<table>
<thead>
<tr>
<th>Main Effects</th>
<th>OR</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI Near</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.71</td>
<td>-0.42</td>
<td>0.65 to 0.79*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3.14</td>
<td>1.24</td>
<td>2.73 to 3.61*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.78</td>
<td>1.24</td>
<td>2.12 to 3.66*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macular Degeneration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.39</td>
<td>0.57</td>
<td>1.07 to 1.81*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.02</td>
<td>0.60</td>
<td>1.54 to 2.66*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. OR = Odds Ratio; β = beta; 95% CI = 95% confidence interval.
*Statistically significant at α = .05.

A second regression model contained all two-way interactions with the exception of the combined effects of visual impairment and eye diseases (e.g., the combined effects of having cataracts and macular degeneration). Interactions that were statistically significant predictors of eye-care use were insurance by income (p = 0.00), race by income (p = 0.00), gender by workplace eye injury (p = 0.02), and age by glaucoma
Table 3-4


<table>
<thead>
<tr>
<th>Main Effects</th>
<th>OR</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.18</td>
<td>2.0</td>
<td>1.08 to 1.30*</td>
</tr>
<tr>
<td>Female (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>2.40</td>
<td>1.58</td>
<td>1.86 to 3.09*</td>
</tr>
<tr>
<td>50-59</td>
<td>1.96</td>
<td>1.30</td>
<td>1.52 to 2.51*</td>
</tr>
<tr>
<td>60-69</td>
<td>1.79</td>
<td>0.95</td>
<td>1.40 to 2.30*</td>
</tr>
<tr>
<td>70-79</td>
<td>1.19</td>
<td>0.28</td>
<td>0.92 to 1.54*</td>
</tr>
<tr>
<td>80+ (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Black</td>
<td>0.79</td>
<td>0.05</td>
<td>0.71 to 0.88</td>
</tr>
<tr>
<td>Other</td>
<td>0.87</td>
<td>0.06</td>
<td>0.77 to 0.99</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.75</td>
<td>0.09</td>
<td>0.63 to 0.89</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;high school</td>
<td>1.35</td>
<td>0.23</td>
<td>1.15 to 1.58*</td>
</tr>
<tr>
<td>high school</td>
<td>1.17</td>
<td>0.14</td>
<td>1.06 to 1.29*</td>
</tr>
<tr>
<td>high school&gt; (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.98</td>
<td>0.74</td>
<td>1.80 to 2.17*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15K</td>
<td>1.49</td>
<td>0.38</td>
<td>1.27 to 1.75*</td>
</tr>
<tr>
<td>15-24.9K</td>
<td>1.44</td>
<td>0.32</td>
<td>1.24 to 1.66*</td>
</tr>
<tr>
<td>25-34.9K</td>
<td>1.31</td>
<td>0.24</td>
<td>1.13 to 1.52*</td>
</tr>
<tr>
<td>35-49.9K</td>
<td>1.15</td>
<td>0.14</td>
<td>1.00 to 1.31*</td>
</tr>
<tr>
<td>&gt;50K (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. OR = Odds Ratio; β = beta; 95% CI = 95% confidence interval.
*Statistically significant at α = .05.
(p = 0.05). All other interactions were thus excluded from the model and the analyses were repeated. According to the Hosmer and Lemeshow Goodness-of-fit test, this model was a good fit to the data since there was not a statistically significant difference between the model prediction and observed values (p = 0.23). According to Negelkerke’s Pseudo $R^2$, this model accounted for only 13.9% of the variation in doctor visits ($R^2 = 0.139$). These results reveal that the variables included in this model have an overall prediction accuracy rate of 67% (including use and non-use predictability); however, this model was better able to predict doctor visits (85% accuracy) than non-use of eye care (36% accuracy).

Possession of insurance combined with income was strongly predictive of eye-care use. People making less than $15,000 annually who did not have insurance were more than 5 times less likely to visit their eye doctor when compared with people making $50,000 or more per year who did have eye-care insurance. Not having glaucoma was also highly predictive of non-use when combined with age, although not having glaucoma seemed to be the main predictor since not having the disease significantly reduced eye-care visits for all age groups (see Table 3-5). Although other combined variables in this model were statistically significant predictors of eye-care use, none were remarkable (see Table 3-5).

Discussion

This study sought to explore how demographic variables such as age, gender, race/ethnicity, education, annual household income, visual impairment, eye disease, and having eye insurance influence eye doctor visits. Investigators also explored the
### Table 3-5


<table>
<thead>
<tr>
<th>Interaction Effects</th>
<th>OR</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insurance × income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No insur/&lt;$15K</td>
<td>5.11</td>
<td>0.01</td>
<td>3.22 to 6.98*</td>
</tr>
<tr>
<td>No insur/$15-24.9K</td>
<td>4.14</td>
<td>1.42</td>
<td>2.43 to 5.78*</td>
</tr>
<tr>
<td>No insur/$25-34.9K</td>
<td>3.97</td>
<td>0.03</td>
<td>2.23 to 5.97*</td>
</tr>
<tr>
<td>No insur/$35-49.9K</td>
<td>2.32</td>
<td>0.00</td>
<td>1.86 to 3.09*</td>
</tr>
<tr>
<td>No insur/$50+K</td>
<td>1.22</td>
<td>-0.06</td>
<td>1.52 to 2.51*</td>
</tr>
<tr>
<td>Insur/&lt;$15K</td>
<td>0.84</td>
<td>-0.36</td>
<td>0.49 to 0.99*</td>
</tr>
<tr>
<td>Insur/$15-24.9K</td>
<td>0.82</td>
<td>-0.20</td>
<td>0.58 to 1.14*</td>
</tr>
<tr>
<td>Insur/$25-34.9K</td>
<td>0.73</td>
<td>-0.32</td>
<td>0.50 to 1.06*</td>
</tr>
<tr>
<td>Insur/$35-49.9K</td>
<td>0.98</td>
<td>-0.03</td>
<td>0.67 to 1.43*</td>
</tr>
<tr>
<td>Insur/$50+K (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age × glaucoma</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40s/no glaucoma</td>
<td>43.08</td>
<td>4.45</td>
<td>19.29 to 96.19*</td>
</tr>
<tr>
<td>40s/glaucoma</td>
<td>13.56</td>
<td>3.76</td>
<td>4.60 to 40.00*</td>
</tr>
<tr>
<td>50s/no glaucoma</td>
<td>33.35</td>
<td>2.61</td>
<td>14.95 to 74.43</td>
</tr>
<tr>
<td>50s/glaucoma</td>
<td>8.22</td>
<td>3.51</td>
<td>3.18 to 21.25*</td>
</tr>
<tr>
<td>60s/no glaucoma</td>
<td>23.93</td>
<td>2.11</td>
<td>10.73 to 53.40*</td>
</tr>
<tr>
<td>60s/glaucoma</td>
<td>8.90</td>
<td>3.18</td>
<td>3.66 to 21.65*</td>
</tr>
<tr>
<td>70s/no glaucoma</td>
<td>12.67</td>
<td>2.19</td>
<td>5.67 to 28.33*</td>
</tr>
<tr>
<td>70s/glaucoma</td>
<td>3.48</td>
<td>2.54</td>
<td>1.35 to 8.96*</td>
</tr>
<tr>
<td>80+/no glaucoma</td>
<td>9.90</td>
<td>1.25</td>
<td>4.37 to 22.39*</td>
</tr>
<tr>
<td>80+/glaucoma (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Race × income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/&lt;$15K</td>
<td>1.30</td>
<td>0.55</td>
<td>1.03 to 1.63*</td>
</tr>
<tr>
<td>White/$15-24.9K</td>
<td>1.24</td>
<td>0.50</td>
<td>1.03 to 1.50*</td>
</tr>
<tr>
<td>White/$25-34.9K</td>
<td>1.33</td>
<td>0.57</td>
<td>1.09 to 1.63*</td>
</tr>
<tr>
<td>White/$35-49.9K</td>
<td>1.21</td>
<td>0.47</td>
<td>1.05 to 1.39*</td>
</tr>
<tr>
<td>White/$50+K (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black/&lt;$15K</td>
<td>1.14</td>
<td>0.29</td>
<td>0.83 to 1.56*</td>
</tr>
<tr>
<td>Black/$15-24.9K</td>
<td>1.44</td>
<td>0.41</td>
<td>1.10 to 1.89*</td>
</tr>
<tr>
<td>Black/$25-34.9K</td>
<td>1.21</td>
<td>0.65</td>
<td>0.87 to 1.70*</td>
</tr>
<tr>
<td>Black/$35-49.9K</td>
<td>1.00</td>
<td>0.48</td>
<td>0.73 to 1.37*</td>
</tr>
<tr>
<td>Black/$50+K</td>
<td>0.60</td>
<td>0.29</td>
<td>0.44 to 0.82*</td>
</tr>
<tr>
<td>Other/&lt;$15K</td>
<td>0.99</td>
<td>-0.22</td>
<td>0.62 to 1.58*</td>
</tr>
<tr>
<td>Other/$15-24.9K</td>
<td>1.35</td>
<td>0.28</td>
<td>0.76 to 2.38*</td>
</tr>
<tr>
<td>Other/$25-34.9K</td>
<td>0.92</td>
<td>0.58</td>
<td>0.48 to 1.76*</td>
</tr>
<tr>
<td>Other/$35-49.9K</td>
<td>2.44</td>
<td>0.20</td>
<td>1.49 to 3.99*</td>
</tr>
<tr>
<td>Other/$50+K</td>
<td>2.32</td>
<td>1.18</td>
<td>1.47 to 3.66*</td>
</tr>
<tr>
<td>Hispanic/&lt;$15K</td>
<td>1.20</td>
<td>1.13</td>
<td>0.87 to 1.65*</td>
</tr>
<tr>
<td>Hispanic/$15-24.9K</td>
<td>0.98</td>
<td>0.47</td>
<td>0.70 to 1.36*</td>
</tr>
<tr>
<td>Hispanic/$25-34.9K</td>
<td>1.23</td>
<td>0.26</td>
<td>0.83 to 1.80*</td>
</tr>
<tr>
<td>Hispanic/$35-49.9K</td>
<td>0.79</td>
<td>0.49</td>
<td>0.53 to 1.16*</td>
</tr>
<tr>
<td>Hispanic/$50+K</td>
<td>0.75</td>
<td>0.05</td>
<td>0.49 to 1.14*</td>
</tr>
</tbody>
</table>
Table 3-5—Continued

<table>
<thead>
<tr>
<th>Gender × injury</th>
<th>0.96</th>
<th>-0.04</th>
<th>0.71 to 1.30*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/no injury</td>
<td>1.04</td>
<td>0.04</td>
<td>0.75 to 1.45</td>
</tr>
<tr>
<td>Male/injury</td>
<td>0.79</td>
<td>-0.23</td>
<td>0.59 to 1.07*</td>
</tr>
<tr>
<td>Female/injury</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. OR = Odds Ratio; β = beta; 95% CI = 95% confidence interval.
*Statistically significant at α = .05.

combined effects of these variables in an effort to predict non-use of eye care. Vision care is recommended by primary and eye-care professionals as a regular part of the continuum of care, since significant eye problems may be asymptomatic initially and early detection of eye pathology is vital to preserve vision, which is beneficial to one’s overall health (American Academy of Ophthalmology, 2007; American Optometry Association, 2008; Zhang et al., 2008). As with previous research, this study showed that a significant portion of the U.S. population aged ≥40 years old is not visiting the eye doctor each year (Bailey et al., 2006); however, this study revealed that over half of the people who did not visit their eye doctor did not have eye insurance, with nearly a quarter of that same group overall blaming cost as the deterrent. Being young, male, white, not having eye-care health insurance, and making less than $50,000 were all predictors of non-use of eye care. Additionally, not having a diagnosed eye condition was also a strong predictor of non-use. Diagnosis of eye disease was the strongest predictor of use, followed by possession of insurance and household income levels, with those in mid-range income levels ($25,000-$35,000) the least likely to visit their eye-care professional. However, these results also revealed that the variables included in these models accounted for very little of the variance in reported non-use of eye care (≈15%). When looking more closely at
model prediction accuracy rates for both use and non-use of eye care, investigators
discovered that the prediction accuracy was low for non-use of care (≈35%), while the
prediction of eye-care use was relatively high when using these variables (≈80%). This
indicates that there are variables important in predicting non-use that were not accounted
for in these models. Those factors may include family history of chronic or eye diseases,
refractive errors, changes in the ability to accommodate near and distance vision (this
usually happens in the early 40s), or a misunderstanding of what “eye-care insurance”
actually encompasses. Unfortunately, the survey used in these analyses did not include
this information.

Because access to care is a complex interaction of individual factors (ability to
pay for services, perceived need to go to the eye doctor) and contextual factors
(community characteristics such as available doctors in a geographic region), there may
be additional reasons for these results beyond those identified in this study. Simply
having eye-care insurance may not reflect those who are underinsured and still unable to
go to their eye doctor due to cost. Household income and age may impact whether a
person has insurance since everyone is eligible for Medicare benefits at age 65, and low
income levels may qualify people for Medicaid; however, regional differences in
coverage plans vary and still may not fully allow for preventive eye care or the treatment
of potentially damaging eye diseases. Additionally, age may influence access, since
people under the age of 60 years old with no personal or family history of eye disease are
recommended to visit their eye doctor every 2 years, resulting in reduced levels of eye-
care use which should not be cause for concern or intervention. Age may also influence
access due to the increase of other health issues related to the aging process, or a result of older patients heeding the advice of their doctors to attend to eye health.

These results indicate that the diagnoses of treatable eye pathologies seem to positively influence doctor visits, perhaps the result of current policies and programs intended to educate those with vision threatening eye conditions. Care should be taken, however, to craft policies, programs, and education initiatives intended to reach target audiences not currently the focus of current initiatives (middle-aged, college-educated white people). Available evidence indicates that many eye conditions are asymptomatic initially, warranting preventive eye care to detect eye disease when vision loss is most preventable in people who may not currently be informed of their risk. Programs and policies must be developed to educate people about the importance of regular eye care in order to prevent damaging eye conditions and monitor eye conditions once identified. The lack of eye-care insurance appears to be a barrier to care based on these results, with nearly half of respondents reporting no insurance and a quarter of people blaming cost for their non-use of eye care; therefore, health care reform should include greater coverage for eye care to avert vision problems, comorbid and secondary conditions related to vision loss, and decreased quality of life. Finally, these results indicate a need to further investigate potential eye-care access barriers for younger Americans and identify eye health disparities related to social determinants of eye health extending beyond the individual and into the community.

This investigation is subject to several limitations. First, data were collected by telephone survey and thus may not be representative of people who do not use the telephone, do not have a land line, have mobility impairments making it difficult to get to
the phone, or have hearing impairments that impede oral communication via the telephone. Second, the data included in this study relied on self-report of visual impairment, eye diseases, and eye-care access and use; therefore, information may not be as accurate as a clinical report and may be influenced by respondents’ interpretation of the questions. Research has shown that respondents may view their vision limitation as less serious, given other topics in a health related survey (Kirchner, 1999; Todorov, 1999). Third, the states included in this study (Alabama, Arizona, Florida, Georgia, Iowa, Louisiana, New York, Ohio, Tennessee, Texas, and West Virginia) may not be representative of the nation as a whole. Also, there is no information gathered in this survey related to personal or family history; therefore, it is difficult to fully assess whether non-use of eye care was necessarily negative or simply a result of individual recommendations from the participants’ eye-care professionals. Additionally, it should be noted that there were significantly more women included in this study than there were men, which may influence the results of both visual impairment/eye diseases as well as eye care generally. Finally, the BRFSS surveys only noninstitutionalized, civilian populations; therefore, these results may not generalize to those living in nursing homes, prisons, military, or other group quarters.

Based on these results, continued national surveillance of eye-care access is vital in order to further assess rates of visual impairment and eye disease as well as access to eye care. These data may serve as evidence of the need for vision-loss prevention and health promotion programs for target audiences currently not receiving program priorities. Furthermore, these data may provide benchmark data for the program monitoring of current initiatives. They may also demonstrate areas of health disparity regarding eye
health and access to care, and assist program planners and legislators in the allocation of scarce resources.

References


The Secretary's Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020. (2008). *Phase I report: Recommendations for the*


CHAPTER IV

FACTORS PREDICTING EYE CARE ACCESS AMONG OLDER AMERICANS WITH DIAGNOSED DIABETES

This study examined factors that influence people with and without diagnosed diabetes to visit their eye-care professional. Factors examined included demographic variables such as sex, age, race/ethnicity, level of education, and household income; self-reported visual impairment (both distance and near) and diagnosed eye diseases/injury; as well as diabetes health management habits (frequency of A1C and independent blood glucose monitoring, history of diabetes education coursework). This study was intended to reveal disparities in eye care and expose the margin of opportunity for policy makers, program planners, and advocates for eye care, specifically for people with diagnosed diabetes.

Background/Significance

Diabetes affects an estimated 135 million people worldwide, a number expected to increase to approximately 300 million by the year 2025 (Venkat Narayan et al., 2000). Investigators also estimate that the rate of diabetes will increase by 42% in industrialized countries and by 170% in non-industrialized countries in the same time period (Venkat Narayan, Gregg, Fagot-Campagna, Englegua, & Vinicor, 2000). In the United States alone, the number of people aged ≥40 with diabetes is expected to triple from 5.5 million in 2005 to 16.0 million in 2050, with the number of people with vision-threatening
complications jumping from 2.1 million to 3.4 million in the same time period (Saaddine et al., 2008). Currently, an estimated 17.5 million people in the U. S. have diagnosed diabetes, a sharp increase from 12.1 million in 2002 (Dall et al., 2008). Additionally, approximately 6.2 million Americans are unaware that they even have the disease (American Optometric Association, 2008b). Dall et al. (2008) attribute the increase in diabetes to the growth and aging of the population, the rising prevalence of obesity, improvements in detection, decreasing mortality, and the growth in minority populations with increased rates of the disease. Of parallel concern to many health professionals is the estimate that 54 million Americans aged 40-74 (40.1% of the population in this age group) have a condition known as “pre-diabetes,” in which their blood glucose levels are elevated but not high enough to classify them as having diabetes, putting them at high risk for heart and circulatory problems as well as the development of type-2 diabetes (American Diabetes Association, 2009).

The financial and personal toll of diabetes has been well documented. Investigators estimate that the cost of diabetes in 2007 was $174 billion, representing actual medical expenditures associated with treatment directly related to diabetes, the treatment of secondary and comorbid conditions, and reduced national productivity such as missed work days (Dall et al., 2008; Halanych et al., 2007). People with diabetes are at increased risk for heart disease, stroke, kidney disease, visual impairment, decreased oral health, amputation, neuropathy and nerve damage, skin disorders, gastroparesis, and depression (Dall et al., 2008; Halanych et al., 2007). However, by following recommendations of health care providers, people with diabetes can increase their
likelihood of avoiding the negative effects of the disease (American Diabetes Association, 2008).

Prevention and treatment of vision-threatening complications of diabetes is available, and yet access to that care remains a problem (Freeland, Crews, Wall Emerson, & Fogarty, 2009; Zhang, Andersen, et al., 2008). The American Diabetes Association (ADA) recommends that people with or at high risk for diabetes work with a comprehensive healthcare team. The recommended team includes the primary care provider, a nurse educator, a registered dietitian, and an eye-care professional. The ADA, along with the American Optometric Association (AOA) and the American Academy of Ophthalmology (AAO), recommends dilated eye exams at least annually (AAO, 2006; ADA, 2008; AOA, 2008b) in addition to A1C and daily blood glucose monitoring, blood pressure and cholesterol control, and neuropathy screening (AOA, 2008a). Regular dilated eye exams are recommended to monitor the potential development of eye-related complications such as retinopathy, glaucoma, and cataracts.

Diabetic retinopathy is the most common microvascular complication of diabetes and results in an estimated 10,000 to 12,000 cases of new blindness annually (Fong, Aiello, Ferris, & Klein, 2004; National Eye Institute, 2009; Tumosa, 2008; Wild, Roglic, & Green, 2004). Important links have been drawn between diabetic retinopathy and race, with blacks and American Indian populations experiencing the highest prevalence but with all races showing increasing prevalence over the past decade (Acton et al., 2001; Kurian & Borders, 2006; National Eye Institute, 2009; Saaddine et al., 2008). The chances of vision-threatening complications from diabetes increase with length of time with the disease (AAO, 2006), and persistent hyperglycemia (Davidson, Ciulla, McGill,
Diabetic retinopathy is a result of the swelling and leaking of the blood vessels in the retina and occurs in four stages defined by the severity of leakage and resulting damage. Investigators at the National Eye Institute (NEI), eye-care professionals at AAO and AOA, and diabetes experts at the ADA warn that the earliest stages may not present symptoms (AAO, 2006; ADA, 2008; AOA, 2008b; National Eye Institute, 2009). In fact, investigators at NEI estimate that 40-45% of Americans diagnosed with diabetes have some form of undiagnosed diabetic retinopathy, further demonstrating the critical nature of annual dilated eye exams (National Eye Institute, 2006).

Despite the strong evidence that annual dilated eye exams are important to monitor and prevent later eye problems, there are significant gaps in the numbers of people with diabetes who have been recommended for annual eye exams and those who actual obtain the care (Beckles et al., 1998; Cook et al., 1999; Dorsey, Songer, Zgibor, & Orchard, 2006; Saaddine et al., 2002). Documented causes for this gap include the patient’s perceived inconvenience of going to the doctor (Pasagian-Macaulay, Basch, Zybert, & Wylie-Rosett, 1997), lack of insurance or inability to pay (Freeland et al., 2009; Zhang, Geiss, et al., 2008), no perceived reason to go (Freeland et al., 2009), and the lack of eye-care professionals in the community (Zhang, Andersen, et al., 2008).

Little is known about the predictive relationship between demographic factors, diabetic management behaviors, and propensity for participation in eye care; however, previous research indicates that there is a complicated interaction between the factors that influence health care access and may lead to disparities in health (Saaddine et al., 2002; Zhang, Andersen, et al., 2008). The term health disparity is most commonly defined in
the United States as a difference in health status adversely affecting particular groups of people who have been linked in the past with discrimination or exclusion. Common characteristics related to this experience are race/ethnicity, socioeconomic status, gender, and disability status including diagnosed diabetes (Carter-Pokras & Baquet, 2002; The Secretary’s Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020, 2008). Despite federal policy prohibiting discrimination of people with disabilities in employment, public services, public accommodations, and telecommunications (The Americans with Disabilities Act [ADA] of 1990), gaps in access still exist, due in part to the complex nature of the experience of living with a disability. Recent amendments to the Americans with Disabilities Act in 2008 (P.L. 110-325) expand the working definition of those protected under the ADA to include limitations in major bodily functions such as the endocrine system, the system affected when a person has diabetes (U.S. Department of Justice, 2009).

Living with a disability such as diabetes or a visual impairment can be described as multidimensional. The dimensions at play include the physical manifestation of the disease causing the impairment, its impact on physical activity and social participation, and the environmental and personal factors that serve as barriers or facilitators to healthy living. A conceptual framework that takes into account this holistic, multifaceted experience and provides a structure by which to describe the impact of the disability is the International Classification of Functioning, Disability and Health (ICF, 2008). The ICF has been described in detail in previous studies (Freeland et al., 2009) and serves as a framework on which to structure health-related assessment survey questions to gain insight into the conceptual clarity of the questions (see Figure 4-1).
In order to expose any possible health disparities for people living with visual impairments and those living with diabetes, research using health-related, population-based data targeting vision and vision health is vital. Previous research examining visual impairment and eye care in the United States explored prevalence rates and utilization of eye care using the Behavioral Risk Factor Surveillance System (BRFSS) (Bailey et al., 2006). The BRFSS is a state-based system of health surveys that collects information about health care access and use, clinical preventive health practices, and health risk behaviors primarily related to injury and chronic disease. It is a cross-sectional random-digit-dialed telephone survey that is conducted by state health departments, with the Centers for Disease Control and Prevention providing technical and methodological
assistance, as well as assistance in aggregating and distributing monthly data. Each state conducts the survey using core questions that every state uses, as well as optional modules that are topic specific, all of which are standardized.

Two modules that are of key interest to the field of vision are the Visual Impairment and Access to Eye Care Module and the Diabetes Module. The BRFSS Visual Impairment and Access to Eye Care Module includes 10 questions related to body functions and structures (e.g., eye diseases such as macular degeneration), the respondent’s ability to complete an activity (e.g., read the newspaper or recognize a friend from a distance), participation in life activities (e.g., visit their eye-care professional), and personal factors (e.g., age, sex, race). There is 1 question in the core survey related to diabetes, and the Diabetes Module contains 12 additional questions regarding age of onset of the disease, the respondent’s current medication habits (e.g., insulin, pills), diabetes management habits (e.g., frequency of blood glucose and A1C monitoring, foot care, participation in diabetes education course), and eye health activities (e.g., visit to eye doctor).

The purpose of this study was to examine the factors that influence the use of eye care and predict non-use based on diabetes health management habits, the presence of a visual impairment, eye disease/injury, vision loss, and social demographic circumstances specifically for people who report having diabetes. Investigators used aggregate data from the 2005, 2006, and 2007 administrations of the BRFSS Visual Impairment and Access to Eye Care Module, along with several questions taken from the Diabetes Module related to eye care and the impact on the disease on eye-care use. This study addressed three research questions. First, what is the impact of diabetes on the prevalence of people in the
U.S. aged ≥40 years who report a visual impairment or eye condition such as cataract, glaucoma, macular degeneration, diabetic retinopathy, and workplace injury, and, further, what is the impact of diabetes on the possession of eye-care insurance? Second, how do those factors together with diabetes management habits influence eye-care visits? Third, are there any significant interactions between variables that help to predict non-use of eye care?

Methods

Study Design

The BRFSS Visual Impairment and Access to Eye Care Module is a state-based, random-digit-dialed telephone survey of the non-institutionalized, U. S. civilian population aged ≥40 years. Investigators in the current study conducted a secondary data analysis of aggregate data for 2005, 2006, and 2007 data from the BRFSS Visual Impairment and Access to Eye Care and Diabetes Modules specifically for the subpopulation of people with diabetes. Investigators were interested in predicting non-use of eye care based on social demographic variables (age, sex, race/ethnicity, education, possession of eye health insurance, and annual family income), self-reported visual impairment (VI), specific eye disease/injury (macular degeneration, cataracts, diabetic retinopathy, workplace eye injuries), and diabetes management habits (frequency of blood glucose monitoring and A1C testing, participation in diabetes management coursework). States that completed both the Visual Impairment and Access to Eye Care Module and Diabetes Module in 2005, 2006 and 2007 were Alabama, Arizona, Florida, Georgia,
Iowa, Louisiana, New York, Ohio, Tennessee, Texas, and West Virginia. Participants were included in the study if they answered questions in the BRFSS Visual Impairment and Access to Eye Care Module and selected questions from the Diabetes Module related to diabetes management habits and the impact of diabetes on the eyes for the same years. For states that implemented the modules in more than one year, the most recent implementation year was used in the analyses. The data were obtained from telephone interviews, with 40,665 people completing all or a portion of the BRFSS Visual Impairment and Access to Eye Care Module and Diabetes Modules in 2005, 2006, and 2007.

Measures

Demographic information (age, sex, race/ethnicity, level of education, and household income) were taken from the BRFSS core survey (see Box 4-1). The continuous variable for age was coded to reflect age categories by decades; sex was recorded as either male or female; level of education was coded to reflect “less than high school,” “high school,” and “more than high school”; and household income was coded to reflect the categories: <$15,000, $15,000-24,900, $25,000-34,900, $35,000-49,900, and >$50,000 (see Box 4-1). All respondents aged ≥40 were given the BRFSS Visual Impairment and Access to Eye Care Module for the states that chose to implement that module for a given year. The study used all responses in the BRFSS Visual Impairment and Access to Eye Care Module. It also included responses to questions the Diabetes Module pertaining to the presence of diabetic retinopathy, and independent diabetes management habits; however, it did not include questions about foot care. Since the data
**BRFSS Core Questions Used:**

12.1 *What is your age? (Continuous variable)*

12.2 *Are you Hispanic or Latino? Yes/no*

12.3 *Which one or more of the following would you say is your race?*
   - White
   - Black or African-American
   - Asian
   - Native American or Other Pacific Islander
   - Other [specify]
   - No additional choices
   - Don't know

12.8 *What is the highest grade or year of school you completed?*
   - Never attended school or only attended kindergarten
   - Grades 1-8 (elementary)
   - Grades 9-11 (some high school)
   - Grade 12 or GED (high school)
   - College 1 year to 3 years (some college or technical school)
   - College 4 years or more (college graduate)

12.10 *Is your annual household income from all sources—*
   - Less than $10,000
   - Less than $15,000
   - Less than $20,000
   - Less than $25,000
   - Less than $35,000
   - Less than $50,000
   - Less than $75,000
   - $75,000 or more

12.20 *Indicate sex of respondent: male/female*

---

**Box 4-1. BRFSS Core Questions Used**

were pooled, questions and responses from 2005, 2006, and 2007 were compared to ensure comparability across years. Questions not replicated in all 3 years were not used in this study. Missing and nonresponses were excluded from analyses.
Respondents were classified as having a distance visual impairment if they answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to the question “How much difficulty, if any, do you have in recognizing a friend across the street?” (BRFSS, 2007, p. 38; BRFSS, 2008a, p. 42; BRFSS, 2008b, p. 37). Participants were classified as having a near visual impairment if they answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” or “unable to do because of eyesight” to the question “How much difficulty, if any, do you have in reading print in newspaper, magazine, recipe, menu, or numbers on the telephone?” (BRFSS, 2007, p. 38; BRFSS, 2008a, p. 42; BRFSS, 2008b, p. 37) (see Box 4-2). A person with a cataract was identified by a positive response to the question, “Have you been told by an eye doctor or other health care professional that you NOW have cataracts?” A person with glaucoma was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?” A person with macular degeneration was identified by a positive response to the question, “Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?” A person with a workplace eye injury was identified by a positive response to the question, “Have you EVER had an eye injury that occurred at your workplace while you were doing your work?” (see Box 4-2). A person with diabetic retinopathy was identified from the BRFSS Diabetes Module if a respondent answered “yes” to the question, “Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?” (BRFSS, 2007, p. 36; BRFSS, 2008a, p. 41; BRFSS, 2008b, p. 36) (see Box 4-3). Eye doctor visits were determined by responses to the question, “When was the last time you visited any eye-care
BRFSS Visual Impairment and Access to Eye Care Module Questions Used:

1. How much difficulty, if any, do you have in recognizing a friend across the street? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don't know
   h. Not applicable (blind)
   i. Refused

2. How much difficulty, if any, do you have reading print in a newspaper, magazine, recipe, menu, or numbers on the telephone? Would you say—
   a. No difficulty
   b. A little difficulty
   c. Moderate difficulty
   d. Extreme difficulty
   e. Unable to do because of eyesight
   f. Unable to do for other reasons
   g. Don't know
   h. Not applicable (blind)
   i. Refused

3. When was the last time you had your eyes examined by any doctor or eye care provider?
   a. Within the past month
   b. Within the past year
   c. Within the past 2 years
   d. 2 or more years ago
   e. Never
   f. Don't know
   g. Not applicable (blind)
   h. Refused

4. What is the main reason you have not visited an eye care professional in the past 12 months?
   a. Cost/insurance
   b. Do not have/know an eye doctor
   c. Cannot get to the office/clinic (too far away, no transportation)
   d. Could not get an appointment
   e. No reason to go (no problem)
   f. Have not thought of it
   g. Other
   h. Don't know
   i. Not applicable (blind)
   j. Refused

(continued on next page)
**BRFSS Visual Impairment and Access to Eye Care Module Questions Used (continued):**

5. When was the last time you had an eye exam in which your pupils were dilated? This would have made you temporarily sensitive to bright light.
   - a. Within the past month
   - b. within the past year
   - c. Within the past 2 years
   - d. 2 or more years ago
   - e. Never
   - f. Not applicable (blind)

6. Do you have any kind of health insurance coverage for eye care?
   - a. Yes
   - b. No
   - c. Not applicable (blind)

7. Have you been told by an eye doctor or other health care professional that you NOW have cataracts?
   - a. Yes
   - b. Yes, but had them removed
   - c. No
   - d. Not applicable (blind)

8. Have you EVER been told by an eye doctor or other health care professional that you had glaucoma?
   - a. Yes
   - b. No
   - c. Not applicable (blind)

Age-related Macular Degeneration (AMD) is a disease that blurs the sharp, central vision you need for "straight ahead" activities such as reading, sewing, and driving. AMD affects the macula, the part of the eye that allows you to see fine detail.

9. Have you EVER been told by an eye doctor or other health care professional that you had age-related macular degeneration?
   - a. Yes
   - b. No
   - c. Not applicable (blind)

10. Have you EVER had an eye injury that occurred at your workplace while you were doing your work?
    - a. Yes
    - b. No

---

*Box 4-2. BRFSS Visual Impairment and Access to Eye Care Module Questions Used* professional? Responses were coded to reflect whether the respondent had visited their eye-care professional in the past 12 months. Access to eye care was further explored
using the questions, "Do you have any kind of health insurance coverage for eye care?"

(BRFSS, 2007, pp. 39-41; BRFSS, 2008a, pp. 43-46; BRFSS, 2008b, pp. 37-40) (see Box 4-2).

**BRFSS Diabetes Module Questions Used:**

**Core: 5.1 Have you ever been told by a doctor that you have diabetes?**
- Yes
- Yes, but female told only during pregnancy
- No
- No, pre-diabetes or borderline diabetes

**Module 3: Diabetes** (to be asked following a "yes" response to Core Q5.1)
1. How old were you when you were told you have diabetes? (continuous)
2. Are you now taking insulin? Yes/no
3. Are you now taking diabetes pills? Yes/no
4. About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do NOT include times when checked by a health professional.
   - a. Times per day
   - b. Times per week
   - c. Times per month
   - d. Times per year
   - e. Never
7. About how many times in the past 12 have you seen a doctor, nurse, or other health professional for your diabetes? (continuous)
8. A test for "A one C" measures the average level of blood sugar over the past three months. About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for "A one C"? (continuous)
10. When was the last time you had an eye exam in which the pupils were dilated? This would have made you temporarily sensitive to bright light.
11. Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy? Yes/no
12. Have you ever taken a course or class in how to manage your diabetes yourself? Yes/no

Box 4-3: BRFSS Diabetes Module Questions Used
Diabetes prevalence was determined by responses to the question “Have you ever been told by a doctor that you have diabetes?” (BRFSS, 2008b, p. 10). The continuous response to the question, “How old were you when you were told that you have diabetes?” was recoded into the categories two categories to generally account for the two types of diabetes (Type I and Type II) distinguished in part by age of onset (≤21 years, >22 years). Diabetes management was determined by responses to the questions: “Are you now taking insulin?” (yes/no), and “Are you taking diabetes pills?” (yes/no), which were coded together to reflect any medication (taking insulin or pills, yes or no). The continuous response to the question “About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do NOT include times when checked by a health professional” was recoded into the categories: <3 times per month, 4-29 times per month, 30-60 times per month, 61-120 times per month, and 121+ times per month. The continuous response to the question “About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?” was recoded into the categories: 0-6, 7-12, 13-24, 25-36, and 37+. The continuous response to the question “A test for A1C measures the average level of blood sugar over the past three months. About how many times in the past 12 months has a doctor, nurse, or other health professional check you for A1C?” was recoded into the categories: 0, 1-4× per year, 5-12× per year, and 13+× per year. Responses to the question: “Have you ever taken a course or class in how to manage your diabetes yourself?” (yes/no) were also recorded (BRFSS, 2008b, pp. 33-36) (see Box 4-3).
Data Analysis

Data were analyzed using the SPSS version 16.0 Complex Samples Module to account for the multistage, complex survey design method (SPSS, 2007). Stratification and weights were used and standard errors were adjusted using stratum information provided in the data (BRFSS, 2008b). Diagnostic tests were conducted to explore bivariate relationships between predictor variables to assess for possible confounding and it was determined that there were no statistically significant correlations between predictor variables (age, gender, race/ethnicity, education, annual income, visual impairment [VI], eye disease/injury, possession of eye-care insurance, and diabetes health management); thus, all predictor variables were included in the study. Forced entry (direct) binary logistic regression was used to explore the predictive relationship between diabetes management, demographic variables, VI, and eye-care variables, and whether the participant went to the eye-care professional in the previous 12 months (yes/no). The forced entry method was used since there was no preconceived idea of the order of influence of the variables included in the model; therefore, all variables were entered into the model at the same time and in no particular order. Assumptions were tested and met by assessing Variance Inflation Factor (collinearity) and by using cross-sectional data (independence of errors). Each model was further assessed for linearity using Hosmer and Lemeshow's Goodness-of-fit test (Hosmer & Lemeshow, 1989).

Main effects and interaction effects were included in separate binary logistic regression models in order to have a sample size large enough to provide sufficient power \( (\beta = 0.80) \) to each model. Main effects were explored in two regression models; one
examined diabetes health management habits while accounting for social demographics, and the other examined diabetes health management habits while accounting for visual impairment and eye diseases. The first model included sex, possession of insurance, race, age, education, income, diabetes age of onset, frequency of blood glucose monitoring, frequency of primary doctor visits due to diabetes, frequency of A1C monitoring, diabetes education attendance, and diabetes medication. The second model included age of diabetes onset, frequency of blood glucose monitoring, frequency of primary doctor visit due to diabetes, frequency of A1C monitoring, participation in diabetes education, diabetes medication, as well as self-reported visual impairment (distance and near tasks), cataracts, glaucoma, macular degeneration, workplace eye injury, and diabetic retinopathy. Finally, an interaction model was run using the combined effects of diabetes health management habits on social demographic and visual impairment variables that were statistically significant predictors in the main effects models. The outcome variable in each model was whether the respondent visited their eye-care professional in the previous 12 months (yes/no).

**Results**

These analyses contained valid data for 7,767 subjects with diabetes (combining $n = 321$ from 2005, $n = 4,202$ from 2006, and $n = 3,244$ from 2007) (see Tables 4-1, 4-2, and 4-3 for descriptive breakdown of the sample by demographics, visual impairment/eye disease, and diabetes health management). Descriptive analyses were run to describe the respondents with self-reported diabetes, their diabetes management habits, and visits to their eye-care professional in the previous 12 months. Investigators found that of the
Table 4-1

*Demographic Make-up of the Sample of Persons Aged ≥40 Years*

<table>
<thead>
<tr>
<th>Demographics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3,095</td>
<td>39.8</td>
</tr>
<tr>
<td>Female</td>
<td>4,672</td>
<td>60.2</td>
</tr>
<tr>
<td><strong>Age in years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>817</td>
<td>11.2</td>
</tr>
<tr>
<td>50-59</td>
<td>1,844</td>
<td>25.2</td>
</tr>
<tr>
<td>60-69</td>
<td>2,240</td>
<td>30.6</td>
</tr>
<tr>
<td>70-79</td>
<td>1,728</td>
<td>23.6</td>
</tr>
<tr>
<td>80+</td>
<td>691</td>
<td>09.4</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>5,419</td>
<td>70.7</td>
</tr>
<tr>
<td>Black</td>
<td>1,379</td>
<td>18.0</td>
</tr>
<tr>
<td>Other</td>
<td>295</td>
<td>03.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>567</td>
<td>07.4</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
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</tr>
<tr>
<td>&lt;High school</td>
<td>1,589</td>
<td>20.5</td>
</tr>
<tr>
<td>High school</td>
<td>2,776</td>
<td>35.9</td>
</tr>
<tr>
<td>&gt;High school</td>
<td>3,378</td>
<td>43.6</td>
</tr>
<tr>
<td><strong>Household income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$15,000</td>
<td>1,485</td>
<td>26.0</td>
</tr>
<tr>
<td>$15,000-24,999</td>
<td>1,645</td>
<td>28.8</td>
</tr>
<tr>
<td>$25,000-34,999</td>
<td>938</td>
<td>16.4</td>
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<tr>
<td>$35,000-49,999</td>
<td>885</td>
<td>15.5</td>
</tr>
<tr>
<td>$50,000+</td>
<td>750</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Eye health insurance</strong></td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>3,968</td>
<td>57.6</td>
</tr>
<tr>
<td>No</td>
<td>2,916</td>
<td>42.4</td>
</tr>
</tbody>
</table>

People with self-reported diabetes, 39% (95% CI = 37-41%) did not have eye insurance. Additionally, 22% (95% CI = 21-24%) of people with diagnosed diabetes reported that they had not been to their eye-care professional in the previous 12 months. The frequency of dilated eye exams (DEE) varied based on possession of insurance, with 32.4% of
Table 4-2

*Visual Impairment and Eye Disease Among the Sample*

<table>
<thead>
<tr>
<th>Vision Health</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance Visual Impairment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,530</td>
<td>22.0</td>
</tr>
<tr>
<td>No</td>
<td>5,440</td>
<td>78.0</td>
</tr>
<tr>
<td><strong>Near Visual Impairment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2,644</td>
<td>43.0</td>
</tr>
<tr>
<td>No</td>
<td>4,330</td>
<td>55.7</td>
</tr>
<tr>
<td><strong>Diabetic Retinopathy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,586</td>
<td>20.4</td>
</tr>
<tr>
<td>No</td>
<td>6,181</td>
<td>79.6</td>
</tr>
<tr>
<td><strong>Cataracts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,681</td>
<td>29.6</td>
</tr>
<tr>
<td>No</td>
<td>4,002</td>
<td>70.4</td>
</tr>
<tr>
<td><strong>Glaucoma</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>701</td>
<td>10.1</td>
</tr>
<tr>
<td>No</td>
<td>6,234</td>
<td>89.9</td>
</tr>
</tbody>
</table>

diabetics without insurance not having had a DEE in the previous 12 months compared to 17% who did have insurance. Of those who did not go to their eye-care professional, 31% (95% CI = 28-35%) did not go because of cost, while 33% (95% CI = 29-37%) did not go because of no perceived need to go. Non-use of eye care for this population varied by race with whites reporting non-use least frequently (21%) and Hispanics and people in the “other” racial group (American Indians, Asians, Alaska Natives, and Pacific Islanders) reporting non-use most frequently (26%).

The prevalence of diabetes varied across demographic factors. Of the people with diabetes, 16% were in their 40s, 27% were in their 50s, 28% were in their 60s, 20% were in their 70s, and 9% were ≥80 years old. The majority of people with diabetes were ≤64
Table 4-3

*Diabetes Management Habits of the Sample*

<table>
<thead>
<tr>
<th>Diabetes Health</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Education Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3,969</td>
<td>51.7</td>
</tr>
<tr>
<td>No</td>
<td>3,702</td>
<td>48.3</td>
</tr>
<tr>
<td>Currently taking pills/insulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1,198</td>
<td>84.4</td>
</tr>
<tr>
<td>No</td>
<td>6,505</td>
<td>55.7</td>
</tr>
<tr>
<td>Diabetes age of onset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤21 years</td>
<td>301</td>
<td>03.9</td>
</tr>
<tr>
<td>&gt;21 years</td>
<td>7,424</td>
<td>96.1</td>
</tr>
<tr>
<td>Glucose monitoring frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3×/month</td>
<td>1,127</td>
<td>14.6</td>
</tr>
<tr>
<td>4-29×/month</td>
<td>1,451</td>
<td>18.8</td>
</tr>
<tr>
<td>30-60×/month</td>
<td>3,625</td>
<td>46.9</td>
</tr>
<tr>
<td>61-120×/month</td>
<td>1,187</td>
<td>15.4</td>
</tr>
<tr>
<td>121+×/month</td>
<td>335</td>
<td>04.3</td>
</tr>
<tr>
<td>Primary care visit/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-6</td>
<td>6,559</td>
<td>84.9</td>
</tr>
<tr>
<td>7-12</td>
<td>688</td>
<td>08.9</td>
</tr>
<tr>
<td>13-24</td>
<td>75</td>
<td>01.0</td>
</tr>
<tr>
<td>25-36</td>
<td>38</td>
<td>00.5</td>
</tr>
<tr>
<td>37+</td>
<td>364</td>
<td>04.7</td>
</tr>
</tbody>
</table>

years old (62%) and 38% were ≥65 years old. It was found that of the people with self-reported diabetes, 64% were white, 16% were black, 14% were Hispanic, and 5% were either multiracial or in another racial category. The prevalence of diabetes increased as people's education level increased, ranging from 21% for respondents with less than a high school education to 47% for respondents with more than a high school education. Diabetes prevalence varied by income level, ranging from 16% for people making over $25,000 per year to 30% for people making $15,000-24,900 per year.
Some people with diabetes also reported visual impairments. About 1 in 4 people with diabetes also reported near visual impairments, while only 1 in 5 reported their doctor ever telling them that their diabetes had affected their eyes. In fact, more people with diabetes reported having cataracts (26%) than having diabetes related eye problems (20%). Bivariate associations for gender, age, race, education, income, and possession of insurance showed no statistically significant correlations.

Diabetes management habits varied for among those with diagnosed diabetes. Blood glucose monitoring ranged from less than 3 times per month to more than 121 times per month (more than 3 times per day). The majority of people with diabetes monitored their blood glucose levels 1-2 times per day (47%), with 13% monitoring it 2-3 times per day and 20% monitoring it weekly or less. Visits to the primary physician due to diabetes were similar for those with insurance than without, with approximately 85% of all people with diabetes visiting their primary care doctor in the previous year due to their diabetes. The blood test referred to as A1C (intended to measure the average glucose level over the previous 3 months) was more frequent with those who had insurance than those who did not. Results indicated that 71% of those with insurance got the test the recommended number of times per year (1-4x), while only 62% of those without insurance got the test.

Three binary logistic regression models were run in order to have a sample size large enough to provide power ($b = 0.80$) to the analysis. Variables were grouped by type: social demographics and diabetes health management habits (model 1); visual impairment/eye disease and diabetes health management habits (model 2); and the combined effects of diabetes management habits, possession of insurance, and income on
social demographic variables (model 3). Diagnostic tests were conducted to explore bivariate relationships between predictor variables to assess for potential confounding. Assumptions were tested and met by assessing Variance Inflation Factor (collinearity) and by using cross-sectional data (independence of errors). All assumptions for running the regression models were met. Data were assessed for linearity by using the Hosmer and Lemeshow’s Goodness-of-fit test (Hosmer & Lemeshow, 1989). Nagelkerke’s Pseudo $R^2$ was used to determine the amount of variance that was explained by each model, a test appropriate for binary logistic regression models (Nagelkerke, 1991).

Included in the first regression model were social demographic variables (i.e., race, sex, possession of eye-care insurance, age, level of education, and income) and diabetes management habits (i.e., age of onset of diabetes, frequency of independent blood glucose monitoring and A1C levels, participation in diabetes education, diabetes medication, and frequency of primary care visits due to diabetes). According to Hosmer and Lemeshow’s Goodness-of-fit statistic, this model was a good fit to the data since predicted values were not significantly different than true cases ($p = 0.86$). This regression model accounted for 14% of the variance (Nagelkerke Pseudo $R^2 = .135$) and was 77% accurate in predicting visits overall (accounting for use and non-use accuracy rates); however, these variables were able to predict use of eye care with 97% accuracy and non-use with only 14% accuracy. Nonsignificant predictors in this model were sex, education, race, age of onset of diabetes, frequency of primary care visits, and whether the participant was taking medication for their diabetes. The second main effects model included visual impairment (distance and near), cataracts, glaucoma, macular degeneration, diabetic retinopathy, workplace eye injury, age of diabetes onset, frequency
of blood glucose monitoring, frequency of primary care visits due to diabetes, frequency of A1C monitoring, participation in diabetes education, and use of diabetes medication. Hosmer and Lemeshow’s Goodness-of-fit statistic again showed that the model was a good fit to the data ($p = 0.24$). This regression model still accounted for 13% of the variance (Nagelkerke Pseudo $R^2 = .125$) and was still 76% accurate in predicting visits overall (accounting for use and non-use accuracy rates); however, the prediction accuracy of eye care use dropped slightly to 97%. These results indicate that the oldest age group ($\geq 80$ years) was the most likely to visit their eye doctor, and was nearly 4 times more likely to use eye care than the youngest group (40-49 year olds) (see Table 4-4). Use of eye care was slightly predicted by level of education with those with more than a high school education about 1.5 times more likely to visit than those with less than a high school education. Use of eye care increased with income; however, those in low- to mid-range income levels were nearly 3 times less likely to visit their doctor when compared with people in the highest income group ($> $50,000/year). Diabetics who frequently monitored their blood glucose and A1C levels and participated in diabetes management classes were slightly more likely to visit their eye doctor than those who demonstrated poor management habits, visiting their eye-care professional approximately 1.5 times more often. According to these results, diabetics who do not have eye health insurance were approximately 2.5 times less likely to visit their eye-care professional than those with insurance, despite recommendations to have annual eye exams.

Included in the second regression model were the variables of self-reported visual impairment and eye disease/injury (cataracts, glaucoma, macular degeneration, diabetic retinopathy, and workplace eye injury). According to Hosmer and Lemeshow’s
Table 4-4


<table>
<thead>
<tr>
<th>Main Effects</th>
<th>OR</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.56</td>
<td>0.94</td>
<td>0.72 to 1.16*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>3.95</td>
<td>1.37</td>
<td>0.85 to 1.90*</td>
</tr>
<tr>
<td>50-59</td>
<td>1.77</td>
<td>1.13</td>
<td>0.65 to 1.61*</td>
</tr>
<tr>
<td>60-69</td>
<td>1.34</td>
<td>0.58</td>
<td>0.10 to 1.05*</td>
</tr>
<tr>
<td>70-79</td>
<td>1.13</td>
<td>0.13</td>
<td>-0.37 to 0.62*</td>
</tr>
<tr>
<td>80+ (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15K</td>
<td>1.74</td>
<td>0.55</td>
<td>0.17 to 0.95*</td>
</tr>
<tr>
<td>15-24.9K</td>
<td>1.41</td>
<td>0.35</td>
<td>-0.02 to 0.71*</td>
</tr>
<tr>
<td>25-34.9K</td>
<td>1.75</td>
<td>0.56</td>
<td>0.17 to 0.95*</td>
</tr>
<tr>
<td>35-49.9K</td>
<td>1.38</td>
<td>0.32</td>
<td>-0.08 to 0.72*</td>
</tr>
<tr>
<td>&gt;50K (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose check/month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>1.50</td>
<td>0.41</td>
<td>-0.26 to 1.07*</td>
</tr>
<tr>
<td>4-29/month</td>
<td>1.54</td>
<td>0.43</td>
<td>-0.22 to 1.09*</td>
</tr>
<tr>
<td>30-60/month</td>
<td>1.12</td>
<td>0.12</td>
<td>-0.52 to 0.75*</td>
</tr>
<tr>
<td>61-120/month</td>
<td>0.88</td>
<td>-0.13</td>
<td>-0.76 to 0.49*</td>
</tr>
<tr>
<td>121+/month (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1C check per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never had an A1C</td>
<td>1.23</td>
<td>0.24</td>
<td>-0.13 to 0.61*</td>
</tr>
<tr>
<td>1-4× per year</td>
<td>0.74</td>
<td>-0.31</td>
<td>-0.63 to 0.01*</td>
</tr>
<tr>
<td>5+× per year (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.39</td>
<td>0.33</td>
<td>0.10 to 0.56*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. OR = Odds Ratio; β = beta; 95% CI = 95% confidence interval.
*Statistically significant at α = .05.
Goodness-of-fit statistic, this model was a good fit to the data since predicted values were not significantly different than true cases ($p = 0.21$). This regression model accounted for 8% of the variance (Nagelkerke Pseudo $R^2 = .084$) and was 61% accurate in predicting visits overall (accounting for use and non-use accuracy rates); however, these variables were able to predict use of eye care with 100% accuracy. It was found that all variables included in this model were significant predictors of eye-care use, thus all were retained. Results revealed that diabetics who reported a visual impairment (near or distance) visited the doctor with nearly the same frequency as those with no reported impairment. People with a diagnosed eye disease did, however, report more eye-care use than those without the diagnoses. People with cataracts, glaucoma, and macular degeneration were approximately 2.5 times more likely to visit their eye doctor than those without these diseases, while people with diabetic retinopathy visited their eye doctor with the same frequency as those without the eye condition according to these results. People with workplace eye injuries visited their eye doctors slightly less frequently than those without eye injuries (see Table 4-5).

The statistically significant predictors from the previous two models were combined with social demographic and visual impairment variables in a third binary logistic regression model. This model contained the combined effects of diabetes education and insurance, age, and income; A1C combined with cataracts, glaucoma, macular degeneration, insurance, age, and income. The statistically significant predictors or non-use of eye care were diabetes education by income, diabetes education by insurance, A1C by insurance, A1C by cataracts, and A1C by glaucoma. These combinations were entered in a new regression model, which was a good fit to the data
Table 4-5


<table>
<thead>
<tr>
<th>Main Effects</th>
<th>OR</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI Distance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.62</td>
<td>-0.48</td>
<td>-0.76 to -0.20*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>VI Near</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.57</td>
<td>-0.57</td>
<td>-0.79 to -0.35*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.88</td>
<td>1.06</td>
<td>0.79 to 1.33*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.32</td>
<td>0.84</td>
<td>0.28 to 1.40*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Macular Degeneration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.18</td>
<td>0.78</td>
<td>0.33 to 1.23*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Workplace Eye Injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.67</td>
<td>-0.41</td>
<td>-0.72 to -0.09*</td>
</tr>
<tr>
<td>Yes (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Age of Onset</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 21</td>
<td>0.47</td>
<td>-0.75</td>
<td>-1.34 to -0.15*</td>
</tr>
<tr>
<td>22+ (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>A1C check per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1.20</td>
<td>0.18</td>
<td>-0.18 to 0.18*</td>
</tr>
<tr>
<td>1-4× per year</td>
<td>0.59</td>
<td>-0.54</td>
<td>-0.86 to -0.22*</td>
</tr>
<tr>
<td>5+× per year (referent)</td>
<td>1.00</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

*Note. OR = Odds Ratio; β = beta; 95% CI = 95% confidence interval.
*Statistically significant at α = .05.
according to Hosmer and Lemeshow ($p = 0.99$). This regression model accounted for 14% of the variance (Nagelkerke Pseudo $R^2 = .135$) and was 74% accurate in predicting visits overall (accounting for use and non-use accuracy rates); however, these variables were able to predict use of eye care with 96% accuracy, but were able to predict non-use by only 14%. While the results indicate that the combined impact of the variables were statistically for these interactions, there was only slight variation in eye care use based on these combinations (see Table 4-6).

Table 4-6


<table>
<thead>
<tr>
<th>Interaction Effects</th>
<th>OR</th>
<th>$\beta$</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Education by Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No edu/&lt;$15k</td>
<td>0.67</td>
<td>-0.40</td>
<td>0.30 to 1.53*</td>
</tr>
<tr>
<td>No edu/$15-24.9K</td>
<td>0.66</td>
<td>-0.42</td>
<td>0.29 to 1.49*</td>
</tr>
<tr>
<td>No edu/$25-34.9K</td>
<td>0.74</td>
<td>-0.30</td>
<td>0.32 to 2.15*</td>
</tr>
<tr>
<td>No edu/$35-49.9K</td>
<td>0.92</td>
<td>-0.09</td>
<td>0.39 to 2.15</td>
</tr>
<tr>
<td>No edu/$50+K</td>
<td>1.20</td>
<td>0.18</td>
<td>0.50 to 2.88</td>
</tr>
<tr>
<td>Edu/&lt;$15k</td>
<td>0.86</td>
<td>-0.15</td>
<td>0.61 to 1.22</td>
</tr>
<tr>
<td>Edu/$15-24.9K</td>
<td>1.16</td>
<td>0.15</td>
<td>0.83 to 1.63*</td>
</tr>
<tr>
<td>Edu/$25-34.9K</td>
<td>0.94</td>
<td>-0.06</td>
<td>0.65 to 1.35</td>
</tr>
<tr>
<td>Edu/$35-49.9K</td>
<td>1.06</td>
<td>0.05</td>
<td>0.74 to 1.50</td>
</tr>
<tr>
<td>Edu/$50+K (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Glaucoma by A1C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No glaucoma/0× per year</td>
<td>0.23</td>
<td>-1.46</td>
<td>0.08 to 0.69*</td>
</tr>
<tr>
<td>No glaucoma/1-4× per year</td>
<td>0.37</td>
<td>-1.00</td>
<td>0.11 to 1.26</td>
</tr>
<tr>
<td>No glaucoma/5+× per year</td>
<td>0.27</td>
<td>-1.33</td>
<td>0.10 to 0.74*</td>
</tr>
<tr>
<td>Glaucoma/0×</td>
<td>0.53</td>
<td>-0.63</td>
<td>0.18 to 1.56*</td>
</tr>
<tr>
<td>Glaucoma/1-4× per year</td>
<td>0.25</td>
<td>-1.30</td>
<td>0.10 to 0.65</td>
</tr>
<tr>
<td>Glaucoma/5+× per year (referent)</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. OR = Odds Ratio; $\beta$ = beta; 95% CI = 95% confidence interval.  
*Statistically significant at $\alpha = .05$.  

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Discussion

This study explored the predictive relationships between social demographic variables and access to eye care (age, gender, race/ethnicity, education, income, possession of eye health insurance), eye disease/injury, and diabetes management habits specifically for people with self-reported diabetes. Vision care is recommended by primary and eye-care professionals as a regular part of the continuum of care and is a vital part of diabetes management, according to the American Diabetes Association, since significant eye problems may be asymptomatic initially and early detection of eye pathology is vital to preserve vision, which is beneficial to one’s overall health (AAO, 2007; ADA, 2008; AOA, 2008b; Zhang et al., 2008). Previous research has shown that a significant portion of the U.S. population aged ≥40 years old are not visiting their eye doctor each year (Bailey et al., 2006); however, until now, no studies have focused such analyses specifically on people with diabetes to describe eye-care use among this population. This study revealed that nearly 1 in 5 (22%) of people with self-reported diabetes had not visited their eye-care professional in the previous 12 months, and nearly 1 in 3 reported no eye-care health insurance. Dilated eye exams varied with nearly twice as many people getting the exam if they had insurance compared to those without insurance. Cost was to blame by one-third of people who did not visit their eye doctor in the previous year, and similar numbers perceived “no reason to go” despite having diabetes.

People with diabetes often reported limits in vision as well as other comorbid eye conditions. About 1 in 4 people with diabetes also reported difficulty seeing near tasks
(i.e., reading a newspaper); however, only 1 in 5 reported having diabetes related vision problems. Interestingly, more diabetics reported having cataracts (26%) than having diabetic retinopathy (20%). People most frequently monitored their blood glucose about 1-2 times per day (47%) and the majority of people with diabetes visited their primary care physician at least once in the previous year because of their diabetes (85%) regardless of whether they had insurance. Not being young, having insurance, having lower incomes, and not monitoring diabetes care generally were strong predictors of non-use of eye care. Also, not having symptomatic eye diseases or difficulties lowered eye-care use by nearly 3 times when compared to diabetics with symptomatic eye conditions (i.e., cataracts, glaucoma, and macular degeneration).

It is important to note that these results revealed that there may be other important factors needed to accurately predict non-use of eye care. Analyses showed that these predictive models accounted for very little of the variance in reported non-use of eye care (≈10%). When looking more closely at model prediction accuracy rates for both use and non-use of eye care, investigators discovered that the prediction accuracy was low for non-use of care (≈10%), while the prediction of eye-care use was relatively high when using these variables (≈95%). This indicates that there are variables important in predicting non-use that were not accounted for in these models. Because access to care is a complex mixture of individual factors (ability to pay for services, perceived need to go to the eye doctor) and contextual factors (community characteristics such as available doctors in a geographic region), there may be additional reasons for these results beyond what was examined in this study. Simply having eye-care insurance may not reflect those who are underinsured and still unable to go to their eye doctor due to cost. Household
income and age may impact whether a person has insurance, since everyone is eligible for Medicare benefits at age 65 and low income levels may qualify families for Medicaid; however, regional differences in coverage plans vary and still may not fully allow for preventive eye care or the treatment of potentially damaging eye diseases. Additionally, age may influence access due to the increase of other health issues related to the aging process, or a result of older patients heeding the advice of their doctors to attend to eye health.

These results indicate that proactive diabetes management habits have a positive influence on eye care, perhaps demonstrating the impact of current diabetes education initiatives and health policies. However, this study reveals that still one-third of people with diabetes are not getting annual eye care despite medical recommendations to do so. With 30% of diabetics perceiving “no need to go” points to a strong need for targeted diabetes education. Additionally, this study reveals that approximately 1 in 3 diabetics knew that they needed to go to their eye-care professional but did not have the funds to do so, indicating an area of need for health policy advocates. Research indicates that diabetes can lead to serious vision-limiting eye conditions, which may be asymptomatic initially. Preventive eye care and diabetic eye monitoring is vital to detect eye disease when vision loss is most preventable; therefore, health care reform should include greater coverage for eye care to avert vision problems, comorbid and secondary conditions related to vision loss, and decreased quality of life. Finally, these results indicate a need to further investigate potential eye-care access barriers for all diabetics to identify eye health disparities related to social determinants of eye health extending beyond the individual and into the community.
This report is subject to a number of limitations. First, the data included in this study relied on self-reported prevalence of visual impairment, eye diseases, and eye-care access and use; therefore, information may not be as accurate as a clinical report and may be influenced by the respondents’ interpretation of the questions based on the general health-related topic of the survey generally. Research has shown that respondents may view their vision limitation as less serious when compared to other topics in a health related survey (Kirchner, 1999; Todorov, 1999). Second, data were collected by telephone survey and thus may not be representative of people who do not use the telephone, do not have a land line, have mobility impairments making it difficult to get to the phone, or have hearing impairments that impede oral communication via the telephone. Third, the states included in this study (Alabama, Arizona, Florida, Georgia, Iowa, Louisiana, New York, Ohio, Tennessee, Texas, and West Virginia) may not adequately represent the nation as a whole. Care should be taken to generalize these results beyond the states represented. Additionally, it should be noted that there were many more female participants in this study than male, which may have an impact on the visual impairments/eye diseases as well as use of eye care. Finally, the BRFSS surveys only noninstitutionalized, civilian populations; therefore, these results may not generalize to those living in nursing homes, prisons, military, or other group quarters.

Based on these results, continued national surveillance of eye-care access for people with diabetes is necessary in order to further assess rates of visual impairment and eye disease as well as access to eye care. These data may serve as evidence of the need for vision-loss prevention and health promotion programs targeted specifically to people who have diabetes or are susceptible to the disease based on family history or medically
indicated symptoms. These results may provide benchmark data for program monitoring and serve as foundational information for healthcare reform that includes comprehensive eye care for people with chronic diseases that can lead to vision loss. They may also demonstrate areas of health disparity regarding eye health and access to care, and assist program planners and legislators in the allocation of scarce resources.

References


CHAPTER V

CONCLUSION

Prevention and control of major eye conditions are available, yet research shows that access to eye care remains a major problem (Saaddine, Narayan, & Vinicor, 2003; Zhang et al., 2008). Public health investigators have recently begun to examine the relationship between demographic and environmental factors that may influence people's decisions and ability to go to their eye-care professional or that may serve as barriers to access (Bailey et al., 2006; Zhang et al., 2008). This study sought to quantify the role of individual characteristics related to access of health care by people with visual impairments. Characteristics were examined in order to predict non-use of eye care for older Americans in the United States. The respective roles of social demographics (sex, age, race/ethnicity, income, education, and possession of insurance), visual impairment and eye diseases, and diabetes health management habits were examined cross-sectionally using the Behavioral Risk Factor Surveillance System (BRFSS) Visual Impairment and Access to Eye Care Module and the Diabetes Module. In this final section, study findings and limitations, as well as implications for future research, will be discussed.

Prevalence of Visual Impairment and Eye Care

The prevalence of visual impairment, eye disease, and eye care for 2007 were examined in the first paper. As previous research has shown (Bailey et al., 2006), prevalence rates varied among states, by age, race/ethnicity, education, and income.
Visual impairment was defined as having difficulty with distance tasks (seeing a friend across the street) or near tasks (reading the newspaper) and varied by state, with Georgia and Alabama consistently reporting the highest levels and West Virginia and Iowa consistently reporting the lowest levels of the states that conducted the Visual Impairment and Access to Eye Care Module and the Diabetes Module. The prevalence of glaucoma and macular degeneration was fairly consistent among states (all between 4% and 5%); however, the prevalence of diabetic retinopathy was slightly higher (18-22%) and workplace eye injury varied the greatest between states from Georgia (7%) to West Virginia (13%). With the exception of diabetic retinopathy and workplace eye injury, women reported higher prevalence of visual impairment and eye diseases than men. Cataracts, glaucoma, diabetic retinopathy, and macular degeneration increased as age increased, while workplace eye injury decreased with age. This study also revealed that prevalence of visual impairment and eye disease/injury varied as a function of race and ethnicity. Blacks reported more distance and near impairments and glaucoma; whites reported more cataracts but reported similar rates of macular degeneration as Hispanics and those in the “other” category (Asian, Pacific Islander, Alaska Native, American Indian, etc.); and those in the “other” category also reported more workplace eye injuries than the other racial/ethnic groups. Prevalence rates consistently decreased as education levels increased and with increasing levels of household income.

Eye-care access was measured in this study by possession of eye-care insurance, history of visit to an eye-care professional in the previous 12 months, and history of a dilated eye-exam in the previous 12 months. For those who did not visit their eye-care professional, reasons for non-use were also explored. It was found that nearly half of all
respondents had eye-care insurance, ranging from 43.7% in Georgia to 49.9% in Iowa. Eye-care professional visits ranged from 25.0% in Iowa to 31.9% in West Virginia, while no reported dilated eye-exam ranged from 46.9% in Alabama to 50.6% in Georgia. West Virginians most often blamed cost for their non-use of eye care (30.4%), while most Iowans claimed to have no reason to go (59.0%). The percent of people without insurance varied by age (from 40.2% for 40-49 year olds to 50.3% for 70-79 year olds), hovered around 45% for both men and women, varied by race (from 39.0% for the category of "other" to 52.3% for Hispanics), decreased as education increased (from 40.5% for those with more than high school to 56.0% for those with less than high school), and decreased as income increased (from 63.3% for those earning less than $15,000 annually to 33.7% for those earning more than $50,000 annually). Dilated eye exam rates were similar across states, hovering around 48%, but increased consistently as age increased. Rates of dilated eye exams were similar based on gender (50%) and race (50%); however, rates decreased as education and income increased. Non-visits to eye-care professionals decreased with age and education, but varied by income, with those in the lowest income group reporting non-use most often (34.8%) and those with mid-range incomes reporting non-use least often (19.5%). Non-use varied slightly by race, but hovered around 38.0% for all groups. Cost was blamed for not visiting the eye doctor most often for those in West Virginia (30.4%), 50-59 year olds (26.8%), women (27.4%), Hispanics (32.1%), and for those in the lowest levels of education (33.2%) and income (47.2%). Across the all variables, nearly 50% of those who reported that they had not visited their eye-care professional in the previous 12 months reported that they had no perceived reason to go.
Factors That Influence Eye Care in the General Population

The second paper explored the predictive relationships between social demographic variables and access to eye care (age, gender, race/ethnicity, education, income, possession of eye health insurance) and eye disease/injury. It was found that a significant number of people are not visiting their eye-care professional annually, nearly half of them perceiving no reason to go, while another quarter blame cost as a deterrent. Overall prevalence and eye-care use was similar in this study, which used aggregate data from 2005, 2006, and 2007. Non-use of care decreased as age increased, and also decreased as education increased. Doctor visits in the previous 12 months varied by race, with 3 out of 4 whites reporting non-use, while only approximately 1 in 10 blacks, Hispanics, and all others reported non-use in the same time frame; and people in mid-range income levels reported the highest non-use rates. This study also revealed that around 1 in 5 people with diagnosed eye diseases did not visit their eye-care professional in the previous 12 months, and as many as half of those with work-related eye injuries did not visit their eye doctor in the same time frame.

Binary logistic regression analyses revealed that having a diagnosed eye disease was the strongest predictor of eye-care use, revealing that once an eye condition was identified, people tended to visit their eye doctor annually. Analyses indicated that those without diagnosed eye conditions were as much as 3 times less likely to visit their eye doctor than those who do have a diagnosed eye condition. Men are less likely to visit their eye doctor than women, as are those in the youngest age category, those without insurance, and those with mid-range incomes, with possession of insurance being the
strongest predictor after having a diagnosed eye disease. When age, income, and insurance were combined with other variables, the impact on non-use was magnified.

Factors That Influence Eye Care for People With Diabetes

The third study explored the predictive relationships between social demographic variables and access to eye care (age, gender, race/ethnicity, education, income, possession of eye health insurance), eye disease/injury, and diabetes management habits specifically for people with self-reported diabetes. This study revealed that nearly 1 in 5 people with self-reported diabetes had not visited their eye-care professional in the previous 12 months, and nearly 1 in 3 reported no eye-care health insurance. Dilated eye exam rates varied with nearly twice as many people getting the exam if they had insurance compared to those without insurance. Cost was to blame by one-third of people who did not visit their eye doctor in the previous year, and similar numbers perceived “no reason to go” despite having diabetes. People with diabetes often reported limits in vision as well as other comorbid eye conditions. About 1 in 4 people with diabetes also reported difficulty seeing near tasks (i.e., reading a newspaper); however, only 1 in 5 reported having diabetes related vision problems. Interestingly, more diabetics reported having cataracts than diabetes-induced eye disease (diabetic retinopathy). Nearly half of respondents reported that they monitored their blood glucose about 1-2 times per day and almost 9 out of 10 diabetics reported that they visited their primary care physician at least once in the previous year because of their diabetes, regardless of whether they had insurance. These results also revealed that insurance, income, and diabetes management were the strongest predictors of use when combined with certain demographic variables.
Not having insurance, having lower incomes, and not monitoring diabetes care generally were strong predictors of non-use of eye care. These results indicate that positive diabetes management habits have a positive influence on eye care; however, one-third of people with diabetes are still not getting annual eye care despite strong recommendations to do so. Of the diabetics who did not visit their eye doctor, approximately 1 in 3 blamed cost, and one-third of the same group reportedly perceived “no need to go.”

Study Limitations

This report is subject to a number of limitations. First, data were collected by telephone survey and thus may not be representative of people who do not use the telephone, do not have a land line, have mobility impairments making it difficult to get to the phone, or have hearing impairments that impede oral communication via the telephone. Second, the data included in this study rely on self-reported prevalence of visual impairment, eye diseases, and eye-care access and use; therefore, information may not be as accurate as a clinical report and may be influenced by the respondents’ interpretation of the questions based on the general health-related topic of the survey generally. Third, the states included in these studies may not be representative of the nation as a whole and may limit the generalizability of these results. Finally, the BRFSS surveys only noninstitutionalized, civilian populations; therefore, these results may not generalize to those living in nursing homes, prisons, military, or other group quarters.
Implications for Prevention

These findings have several implications for public health research, policy, practice, and education. In order to frame these recommendations, they have been fitted to the ICF to assist in focusing surveillance, public policy, program planning, and monitoring activities (see Table 5-1). While the original intent of the ICF was to assist in framing the multidimensional experience of living with a disability, this dissertation project utilizes the ICF in a fresh and innovative manner. This set of studies demonstrates the usefulness of using the ICF in a dynamic and predictive approach to the exploration of the experience of living with a disability, identifying key factors in various domains in order to anticipate areas of need or devise solutions to known barriers. Future studies should explore the value of using the ICF model in this dynamic way in addition to the traditional, static approach to its use.

Continued state-level surveillance is vital in order to fully assess the regional impact of social demographic determinants of visual impairment, eye disease and access to eye care. State-specific programs and policies should be carefully considered based on that surveillance in order to meet the eye-care needs of people based on regional differences, the demographic make-up of states, and trends in prevention care. Education programs and initiatives must be made fully accessible for target populations, including people who have difficulty accessing print and graphic information such as those with visual impairments. Diabetes health management education, services, and technology must also be made accessible so that the people at highest risk for vision loss due to the
Table 5-1

Recommendations for Public Health/Vision Rehabilitation Fitted to the ICF

<table>
<thead>
<tr>
<th>Disease</th>
<th>Structure/Function</th>
<th>Activity</th>
<th>Environment/Participation</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target eye health education to those at high risk for vision threatening eye diseases/injuries</td>
<td>(domain not examined in this project)</td>
<td>Include vision rehabilitation training as part of the continuum of eye care</td>
<td>Health reform must include eye care</td>
<td>Further examine eye health inequities based upon health disparity</td>
</tr>
<tr>
<td>Monitor programs and policies for effectiveness and efficiency</td>
<td>Expand Medicare/Medicaid benefits to include comprehensive eye care</td>
<td>Ensure that education programs and diabetes management services are fully accessible for people with visual impairments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

complications of diabetes have the information and tools needed to make good decisions about their own health and eye care.

In addition to program initiatives, health policy reform must be infused with strategies targeting affordability and accessibility of eye health care for all. Health policy advocates should consider including extensive eye-care coverage for Medicare and Medicaid beneficiaries to remove barriers to care for those most at risk for eye diseases and potentially limiting visual impairment. Additional policies should be crafted to assist in cost-containment based on need and ability-to-pay. Prevention and monitoring
activities may be linked to pay-for-performance economic incentive programs for eye-care professionals to further increase the number of providers willing to provide care to high-risk patients and those with diagnosed eye disease and diabetes. These data may serve as evidence of the need for vision-loss prevention, health promotion, and diabetes education programs to targeted populations at high risk for vision-threatening chronic or eye conditions and to those with demonstrated limited access to eye care. These data may also serve as benchmark information for the monitoring of new and current programs in order to assess program effectiveness and efficiency.

Questions for Future Research

In this study, several individual characteristics were shown to be predictive of non-use of eye care: the presence of a diagnosed eye disease, social demographic factors (insurance and then income), and diabetes management habits, with diagnosed eye disease being the most predictive in the general public, and diabetes management habits being the most predictive in the diabetic subpopulation. Replication of this work across other states that implemented the BRFSS Visual Impairment and Access to Eye Care Module and the Diabetes Module is needed to determine the generalizability of the findings of these particular studies. Specifically, future research might focus on the following questions:

*Social Demographic Variables:*

1. Examine the impact of under-insurance on use of eye care.

2. Investigate the influence of culture and language on eye care use and beliefs.
3. Explore state/regional Medicaid/Medicare policies related specifically to use of eye care.

**Visual Impairment/Eye Disease:**

1. Examine the impact of multiple eye diseases on eye care usage.

2. Explore the influence of family history of eye disease, visual impairment, and vision-threatening chronic diseases.

3. Identify additional chronic diseases that influence eye-care use.

**Diabetes Management:**

1. Identify additional factors that influence the perceived need to visit an eye-care professional.

2. Explore diabetes education curricula for content related to eye care and prevention/monitoring of vision.

3. Examine current diabetes education curricula for accessibility of content for people with vision-limiting eye conditions.

4. Re-examine the impact of social demographics on eye-care use for both those with diabetes and those without.

References


Appendix A

Human Subjects Institutional Review Board
Letter of Approval
Date: January 7, 2009

To: Robert Wall Emerson, Principal Investigator
   Kieran Fogarty, Co-Principal Investigator
   Amy Freeland, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 09-01-04

This letter will serve as confirmation that your project "Visual Impairment and Eye Care among Older Adults: Secondary data analysis of the BRFSS Vision and Diabetes Modules" has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: January 7, 2010