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The Relationship of Location and Educational Achievements to Vision Impairment in Asians

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2018

Abstract

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MBA, University of Phoenix, 2008

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Public Health

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Abstract

Increasing incidence of vision impairment in the United States reinforces the urgent need for research and public health awareness. Eye diseases are of common concern in Asian and other ethnic groups globally. Glaucoma, cataracts, macular degeneration, myopia, and retinitis are types of eye diseases and common causes of vision impairment in Asians. This study addressed the current gap in knowledge regarding vision impairment prevalence among Asian-Americans by geographical location and level of education. Socio-ecological theory was used as the theoretical foundation.

A cross-sectional secondary dataset from U.S. Census Bureau included 3,916,947 participants' survey responses from 2011 through 2015 which was analyzed using a logistic regression model. The model addressed the relationships between variables such as education level, geographic location, and vision impairment.

The results in this study exhibited that educational level and geographic location were statistically significant, $p < 0.001$ and $p = 0.004$ respectively and they were determined as predictors of vision impairment among Asian-Americans. The statistical significance $p < 0.001$ for age and gender as confounders in the results exhibited that the variations in these confounders were responsible for vision impairment prevalence.

The findings from this study have positive implications for social change among Asian-American communities. This can serve as a basis for exploring the relationships between vision impairment and other social or environmental factors which have not yet been assessed.

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Dedication

This research project is dedicated to my beloved and reverend all family members of Bakul S. Trivedi.

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I dedicate this work to my parents, Mr. Bakul Trivedi and Mrs. Nalini Trivedi who have been my inspiration and main source of encouragement throughout my educational career. The sacrifices and support from them have helped me to achieve my goal.

Above all, I thank God for always being with me at every need of the hour and carrying me through the difficult times. I bow my head in utter humility and complete dedications.

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Chapter 1: Introduction to the Study

Introduction

Vision impairment is of increasing concern to public health professionals, and by advancing understanding of various eye diseases, health practitioners could promote meaningful health promotion measures, and individuals at risk could reduce or minimize the risk of vision impairment (Scott, Bressler, Ffolkes, Wittenborn, & Jorkasky, 2016). Glaucoma, cataracts, macular degeneration, myopia, and retinitis are common eye disorders associated with vision impairment. Glaucoma is a major eye problem and public health concern because it is responsible for irreversible blindness and affects millions of people worldwide (Pan & Varma, 2011). Cataracts also cause blindness and are a public health burden because, in 2010, one in three people were reported blind due to cataracts (Khairallah et al., 2015). There have been some studies conducted to understand the causality of vision impairment. Some researchers have suggested that genetics and lifestyle factors, such as cigarette smoking, diabetes, low glycemic diet, and age can lead to vision-related problems such as glaucoma, cataracts, and age-related macular degeneration (Kang et al., 2016). Socioeconomic status (SES) could be measured by individual status in the society, education level, financial status, or social status (Whillans & Nazroo, 2016). Zhang et al. (2013) assessed the need for eye care services for detection, assessment, and care at regular intervals, and they found that people with high educational attainment visited a clinic for eye care services more frequently than did people with low educational attainment. Mantel (2016) found that early detection of macular degeneration is crucial because late detection could threaten vision and may result in vision loss. Some researchers have described high risk for vision impairment in Asians as compared to the other ethnicities. Fisher et al. (2015) assessed visual impairment as it relates to demography, socioeconomic, and health characteristics in a multi-ethnic cohort study and found that visual impairment was specifically high among Chinese men and women as compared to their white counterparts. Also, Stein et al. (2011) stated that, due to the rapid rise in the number of Asian Americans in the U.S. population, there is a need for treatment advancement and that care providers should be aware of the increased risk of open-angle glaucoma, narrow-angle glaucoma, and normal-tension glaucoma in the Asian population. Awareness regarding health condition is crucial because unawareness can lead to uncontrollable adverse health conditions. Vision impairment and blindness are increasing in the United States and around the world, which ultimately affects the overall national health status and quality of life (Varma et al., 2016). In 2015, 1.02 million people were reported blind due to eye disorders, and this number is expected to reach 2.01 million by 2050 (Varma et al., 2016).

Background

Due to increased immigration in the United States, the number of cases of eye diseases has increased, thus substantially increasing the overall national risk of vision impairment. Early detection and regular eye check-ups could prevent premature blindness. For example, the glaucoma risk could be caused by intraocular pressure (IOP), although vision loss is not entirely dependent on IOP; however, early detection could prevent this disease (Davis, Crawley, & Pahlitzsch, 2016). Other potential risk factors may also impact eye diseases and the disease prevalence. Therefore, I designed this study to assess associations between educational attainment and geographical distribution risk factors and vision impairment. Fisher et al. (2015) examined different factors as opposed to my proposed study. Cumberland and Rahi (2016) also assessed various factors and populations for vision impairment prevalence. My study is unique because I am exploring the relationship between level of education and/or geographical residential locations of individuals and vision impairment within the Asian community.

Problem Statement

Many researchers have provided objective research-based evidence for the need to support further exploration of the effects of education level and geographical location on health outcomes (Cohen, Chavez, & Chehimi, 2012; Creswell, 2009; Whillans & Nazroo, 2016). In this study, the adverse health outcome under investigation is the prevalence of vision impairment among the Asian population within the United States. Understanding how vision impairment is connected to educational status and the geographical location could play a vital role in health promotion and preventative measures in public health and epidemiological fields. The prevalent state of a given health outcome is indicative of the health status and quality of life of the target population in a nation (Cohen et al., 2012; Creswell, 2009).

Purpose of the Study

In this dissertation, no causal inference was drawn. However, a correlational inference between the predictor variables (education level and geographical location) and vision impairment was made. This comparative research inquiry on the health effects of education level and geographical location on vision impairment has not been addressed in other studies (Rooks-Ellis, 2014). The absence of a conclusive evidence-based finding on this issue necessitates research that is focused on assessing the health implications of education level and geographical location on vision impairment to promote a better intervention among the target population and individually based health assessments. In this study, I used secondary data to address the association between education level or geographical location and vision impairment. The implications of geographical location and education level for vision impairment are described in detail in the following sections.

Geographical Distribution Globally for Vision Impairment

It is difficult and challenging to address geographical distribution on the prevalence of vision impairment because people move around and migrate to different locations. Resnikoff and Keys (2012) discussed the prevalence and causes of global blindness; they explored and encountered several limitations and showed that the distribution for vision impairment varied significantly with a high peak for cataract in 2010. They also found that some of these limitations were due to lack of clarity on the exact causes of vision impairment, use of methodology, and absence of data in various geographical locations (Resnikoff & Keys, 2012).

Geographical Distribution in the United States for Vision Impairment

Exploring the distribution of vision impairment cases in the global setting and capturing it accurately can be difficult and challenging due to massive and constant migrations of people. A similar situation can be described for the distribution of vision impairment cases in the United States. In the United States, almost all population migrated from different countries. However, in this study, I explored the relationship between vision impairment diagnosis and geographical location for an individual's residence in the United States. Such information could be helpful in determining if there is a directional trend between the factors of interest and the health outcome under investigation, which could be useful from a public health perspective. Zebardast, Friedman, and Vitale (2016) estimated and examined the number of presented near-vision impairment cases in the United States based on their sociodemographic characteristics. They found that 1 in 8 Americans above 50 years of age who are non-White-male, have lower education, lack private insurance, and are at poverty status level were prominent for presented near-vision impairment.

Educational Attainment and Risk of Vision Impairment

Shrestha, Guo, Maharjan, Gurung, and Ruit (2014) assessed health literacy on various ocular diseases in Nepal and found that such diseases were related to risk factors such as gender (female specifically), advanced age, low levels of education, and rural habitation. Poor health literacy could promote the lack of interest in receiving the available, necessary, and timely health care services. Thus, in this study, I explored the relationship between the level of education and vision impairment. Education is important because through education and informed awareness, people could understand the temerity of the health problems that they are facing. Feinberg et al. (2016) assessed adult educational attainment status with health seeking behaviors and found that indicators such as internet use, English literacy in the house, and attainment of at least a high school diploma, were most important for improve understanding of health care.

Factor such as having English as a second language, which is not frequently spoken or a means of communication in the household, could affect understanding of the consequences of the disease and when to take actions to stop progression of the illness or seek alternative/available health service/treatment (Jacobson, Hund, & Mas, 2016).

Therefore, I conducted this study to address the gap in research regarding geographical distribution and vision impairment among the Asian population in the United States. I also explored the relationship between the level of education and vision impairment prevalence among the selected target population. The gap in literature, as specified by Rooks-Ellis (2014), revealed that further study is needed to explore the relationship between education status and geographical distribution of individuals with vision impairment. The outcome of this study can advance understanding of vision impairment characteristics and provide information to public health professionals for their future research. In this study, I assessed educational attainment level against vision impairment. Other socioeconomic factors may influence vision impairment prevalence, but in this study, only educational attainment factor was selected. Other socioeconomic statutory factors that could influence vision impairment include social determinants of health and inequalities such as income, the number of family members living in the house, poverty, home ownership or rental status, and marital status (Whillans & Nazroo, 2016). The findings from this study provided actionable and comprehensive information on the links between geographical distribution, level of education, or both and vision impairment diagnosis, preventative measures, and health promotion measures in the United States.

Research Questions and Hypotheses

The following research questions (RQ) and hypotheses formed the fundamental research inquiry basis in this study:

RQ1: Were there associations between vision impairment prevalence and level of education (no school, high school, college, and advanced degree)?

$H_0$1: There were no associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence

H_a1: There were associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

RQ2: Were there differences in the prevalence of vision impairment among Asian-Americans based on the geographical locations of residence (east, west, north, and south).

$H_0$2: There were no differences between geographical locations (east, west, north, and south) and vision impairment prevalence

H_a2: There were differences between geographical locations (east, west, north, and south) and vision impairment prevalence.

Selected articles relating to vision impairment and various factors affecting this disease were described below:

1. Taylor (2016) indicated that prevalence of blindness has increased rapidly and that at least 32 million people were blind and 191 million had poor vision. The curve for blindness increased between 1990 and 2010.

2. Gipson (2013) stated that age-related eye problems are becoming costly in the United States because at least 14.4% of the population over 50 years of age have dry-eye symptoms, a common indicator for eye problems.
3. Ko, Hwang, Chen, Lee, and Liu (2016) described the relationship of SES with glaucoma awareness and stated that lack of awareness about the risks for glaucoma could prevent individuals at risk from getting the proper care they needed.
4. Jonas et al. (2014) found that prevalence of blindness in South Asia was three times higher than in Central Asia and globally, that women were affected more than men, and that cataract and under-corrected refractive error were major causes of blindness.
5. Cumberland and Rahi (2016) indicated that there could be adverse impact of SES differences on vision impairment and blindness. The authors found that inequalities in social position could hinder the well-being of individuals.

Theoretical Framework

In this study, I employed the social ecological theory as the theoretical framework. The social ecological theory is a model that can be used to assess the relationship between various personal and environmental factors (Bronfenbrenner, 1979). For example, Harvey, Oldfield, Chen, and Eschbach (2016) used this model to assess the relationships of several factors with melanoma among Hispanics in the United States. Also, Thetford, Bennett, Hodge, Knox, and Robinson (2015) used the social ecological theory and meta-analysis approach to assess resilience with vision impairment, which helped the investigators in further advancement of the opportunities that allowed health care providers to understand health and well-being of people based on their social, economic, and emotional statuses. Clearly, on the individual level, some people adjust better in coping with vision related issues than others, and some are more resilient (Thetford et al., 2015). Social and ecological factors such as the level of education and geographical locations could increase the morbidity risks associated with vision impairment. The purpose of applying the social-ecological theory in this study, however, is that it is a better theory to help explain the intrinsic and extrinsic aspects of the education level and/or geographical residential location and the prevalence of vision impairment.

Nature of the Study

The survey approach employed in this study could only be used to draw a quantitative correlational inference if any existed. Secondary data were employed. The data for the study was collected from a pre-existing survey dataset. The dataset source was the Centers for Disease Control and Prevention (CDC; Kirtland et al., 2015). The data were available and accessible in the CDC's weekly review report. The data was collected by the U.S. Census Bureau (2016). To assess the level of integrity of the secondary data, I have evaluated a systemic review, which included codebook evaluation, data dictionary assessment, coding and recoding information. Ultimately, the focus of the data analysis in this study must align with the posed research questions on the assessment of the effects of geographical locations and educational attainment on the prevalence of vision impairment among the population under investigation.

Definitions

Dependent variable: Also known as an outcome variable. This variable is a result of an effect of an independent variable (Cresswell, 2009).

Education level: The highest level of education achieved by an individual. In this study, the level of education is categorized into four groups: high school, bachelors, masters, or advanced degree (United States Census Bureau, 2016).

External validity: The basic component that allows the researchers to assess the extrinsic quality of the research integrity to allows investigators to minimize or reduce spurious errors due to the inherent extrinsic variations of the influencing variables or factors (Cresswell, 2009). It also allows for possible generalization inference, when appropriate and necessary (Cresswell, 2009).

Geographical location: In this context, the residential environment or regions an individual or target population lives in the United States (Kirtland et al., 2015).

Independent variable: Also known as a predictor variable. This variable is manipulated to influence an effect in the form of an outcome (Cresswell, 2009).

Internal validity: The basic component that allows the researchers to assess the quality of the research integrity to allow investigations to minimize or reduce spurious errors due to the inherent intrinsic variations of the influencing factors (Cresswell, 2009).

Morbidity: Having a disease or symptom of disease, or the rate of disease in any given population. (Varma et al., 2016).

Outcome variable: Also known as a *dependent variable*. This variable is a result of an effect of a predictor variable (Cresswell, 2009).

Predictor variable: Also known as an independent variable. This variable is manipulated to create an effect in the form of an outcome (Cresswell, 2009).

Prevalence: The overall frequency or rate of the occurrence of a given health outcome or event within a given time-period among population at risk. (Varma et al., 2016).

Quality of life: The health status, comfort state, and enjoyment experienced by an individual (Varma et al., 2016).

Social change: An advancement to or a motif for behavioral change, cultural, or societal value improvement (Crosby, DiClemente, & Salazar, 2013).

Vision impairment: Partial or complete blindness as a result of an eye disease or condition (Kirtland et al., 2015).

Assumptions

The assumption in this study was related to the plausibility of the association between geographical location and vision impairment existed, and it was meaningful and worthwhile to be explored further. To understand and explore the plausible assumptions on the associations between geographical location and vision impairment or between educational attainments and vision impairment, I conducted an in-depth literature review on related topics and studies. For instance, Marmamula, Keeffe, Narsaiah, Khanna, and Rao (2013) conducted a cross-sectional study in Andhra Pradesh, India to evaluate vision impairment, refractive errors, and eyeglasses use in various geographical locations. In the study, Marmamula et al. (2013) concluded that the prevalence of vision impairment and refractive errors decreased from one geographical location to the other, but the use of eyeglasses increased from one geographical location to the other. Based on this evidence-based assumption demonstrated in this study, it was indicative of the nature of the effect of geographical residential location could exert on a given health outcome within a specific target population.

The findings from this dissertation provided further elucidating information on the plausible links between the specified predictor variables and the health outcome under investigation. A cross-sectional study was conducted by Bruce, Fairley, Chambers, Wright, and Sheldon (2016) on the assessment of the prevalence of poor vision in children aged 4-5 years and the impact of visual acuity due to literacy in the United Kingdom. Bruce et al. (2016) concluded that reduced visual acuity at school entry was due to the reduced literacy and high prevalence of poor vision. Based on this finding, it became plausible that there was an association between level of education and vision impairment.

Scope and Delimitations

One of the major delimitations of this study involved with the selection of the participants. In this study, only the Asian-American population was selected for the statistical assessment of the links between the specified predictor variables and posed health outcome. I selected this exclusive target based on the gap identified in the literature and the fact that the Asian-American community are considered at high risk for developing eye diseases or conditions at any age compared to other racial groups or communities (Varma et al., 2016). The factors associated with the eye disorders are necessary indicators for understanding the overall effects and variation of the eye diseases in this community.

I explored education level and geographical location as variables in this study because they have not been considered the primary predictor variables in any other studies. The association between educational level and vision impairment or between the geographical location and vision impairment were investigated separately. As a result, I did not evaluate these associations together. In other words, I posed an individual research question for each predictor variable (geographical location or education level) independent of the other predictor variable. However, some confounding variables or covariates could affect a health condition (Baylor, Yorkston, Bamer, Britton, & Amtmann, 2010). Such known covariates were accounted for in the statistical analysis stage of this study.

Limitations

One of the main limitations in this study was the data integrity as it was related to the posed research question. For example, the type of measuring tool used by the secondary data source could substantially affect the data analysis integrity. Ultimately, in any study, the data collection and measuring tools provide the basic foundation for the quality of the assessments. For instance, outcome effects may differ by age. The level of education could vary by the age, for example, an 18-year-old participant may still be in school or college, so their educational attainment would be limited to a high school or some college level degree.

The variation of educational attainment by age posed a potential risk to the internal and external validity. To reduce this type of spurious error or confounding effect I employed stratification in the statistical analysis stage for all the possible confounders or covariates to assess possible interaction and attributable effects. Such variables were added to the logistic model. In addition, Kimberlin and Winterstein (2008) emphasized that the secondary data under review for this study were collected using a self-report approach, which could induce a recall bias and misclassification bias. These researchers also suggested that with a cross-sectional research design, only correlation inference could be advanced in the absence of an experimental research design approach (Kimberlin & Winterstein, 2008).

Significance of the Study

The significance of the study was not only in the scientific contributions but also in the inherent positive social change associated with the implications of this study at the individual, organizational, or societal level. In addition to the scientific contributions that this study findings advanced knowledge in the professional discipline of public health and epidemiology, the findings from this study helped in promoting awareness drive, advocacy platforms and policy making processes. For instance, in communities where there was low interest in action-based participatory awareness and health education due to the cultural, language, religious, and personal differences, provision of evidence and clarity on the links between vision impairment and education level and/or geographical residential location played a substantial role in public health promotion measures. Ma et al. (2014) raised concerns about low participation observed in Asian Americans in clinical trials due to cultural and language differences and how culturally and linguistically tailored interventions could help promote participation in this community. Access to health care for the diseases in Asian American communities has been a concern because of language barriers, cultural differences, and trust (George, Duran, & Norris, 2014).

This study's findings lead to a positive social change by providing the necessary information on how to reduce potential health disparities inherent in the Asian communities. Social change was driven by promoting health care in minority populations that faced some health care challenges and that needed health initiatives that improved health status to facilitate the quality of life in those communities (Crosby et al., 2013).

Summary

In summary, many researchers have pointed out the need for further research on the effect of education level and geographical location on adverse health outcomes. In this study, I assessed associations of education level and geographical locations with vision impairment. The secondary data were used in this study in which the dependent variable is vision impairment and independent variables were education level and geographical locations. The targeted population for the study was Asian Americans. The reason for selecting this specific community was that Asian Americans seemed to have a high risk for eye diseases and could be affected by factors such as geographical location and education level. The results of the study can advance positive social change within the target population in question.

Chapter 2: Literature Review

Introduction

In Chapter 2, I discussed vision impairment prevalence, statistics, characteristics, and possible relationships with various factors based on the findings from the review of primary peer-reviewed body of literature.

Eye Health Research

A number of researchers have written about the importance of vision-related research. According to Spaeth (2013), ophthalmic research was important because the outcomes of such research, helped researchers explain function and feelings about vision-related problems. Research activities not only foster knowledge about the topic but also help researchers to establish evidence-based decision making when addressing patient needs (King, Thomson, Rothstein, Kingsnorth, & Parker, 2016). The research provided knowledge to the researchers so that they were able to address vision problems. Wills Eye Research Center conducted a 2-year study to understand and execute an intervention program in the community to manage and detect eye diseases earlier in time so that premature blindness could be prevented (Hark et al., 2016). This community-based research study was designed to improve eye care for the residents of Philadelphia for whom the program was specifically designed to improve glaucoma via educational workshops among African American populations aged 50+ years and all adults 60+ years and any other with family history of glaucoma (Hark et al., 2016). From this study, Hark et al. (2016) were able to improve awareness for eye health among 1074 participants who attended the workshops and 1508 participants who made appointments for the eye exams.

Even though the investigators only focused on glaucoma awareness, such programs can also benefit eye health in different communities. The key message from this research was to spread awareness. Scott et al. (2016) emphasized the importance of understanding eye health because it can preserve vision in Americans and help policy makers to prioritize eye research. These investigators used a population survey which included 20,144 U.S. adults and found that 87.5% (95% CI, 84.5%-90%) of those surveyed believed that good vision was good overall health, whereas 47.4% (95%CI, 43.7%-51.1%) considered vision loss as the worst possible health outcome but 25% were not aware of any eye conditions (Scott et al., 2016). The investigators found that many Americans were unaware of the consequences of eye diseases and that there was a need for education and awareness enhancement in all communities (Scott et al., 2016). Eye diseases were often ignored, and eye care is crucial for better overall vision health.

What is Vision Impairment?

Vision impairment is blindness and is often premature. Multiple eye diseases can lead to vision impairment, namely glaucoma, macular degeneration, retinitis, cataracts, myopia, and diabetic retinopathy. Vision impairment impacted many communities worldwide. The reasons for and cases of vision impairment and blindness were distributed differently among different racial groups according to demographic data from from the 2000 survey conducted by the U.S. Census Bureau (Congdon et al., 2004). The problem was that some eye diseases, such as glaucoma, do not show symptoms until they progress (Weinreb et al., 2016). Glaucoma impacts 64.3 million people between the ages of 40 and 80 worldwide and mainly responsible for irreversible blindness (Chang &

Singh, 2016). Macular degeneration is another vision impairing disease which affected the retina mostly in individuals above 50 years of age, but it also impacted younger adults (BrandI et al., 2016). Cataracts were also responsible for significant blindness worldwide; however, this blindness may have been easily avoided (Lee & Afshari, 2016). Myopia was common in children and young adults, and even though this disease showed traces of genetic involvement, researchers report of 28.3% prevalence currently worldwide with an increase to at least half of the population by 2050 (Hopf & Pfeiffer, 2016). Retinitis, or night blindness, deteriorates the pigment of the retina by causing night blindness and reduces the overall visual field (Natarajan, 2011). Diabetic retinopathy was also responsible for vision impairment; in a global survey in 2010, 3.7 million people were reported as visually impaired worldwide due to diabetic retinopathy (Leasher et al., 2016).

Visual Impairment Characteristics

Characteristics of visual impairment were related to the problems created by low vision and blindness. For example, glaucoma could lead to low vision and blindness. Szlyk, Mahler, Seiple, Edward, and Wilensky (2005) assessed driving performance among glaucoma patients and measured their vision capabilities. Per Szlyk et al., reduction in vision capabilities in the glaucoma patients put them at high risk for accidents. Identification of risk factors for visual impairment could help healthcare professionals to provide control measures. Vision awareness was important, and this awareness could be designed based on the identification of risk factors associated with the eye disease (Xu et al., 2016). An observational, cross sectional study conducted in

China on 100 patients in a cornea clinic revealed that old age, being male, and residing in a rural area were risk factors associated with worse visual impairment and the study became critical in the design of awareness (Xu et al., 2016). Age-related macular degeneration has been assessed with various factors. Rasoulinejad et al. (2015) conducted a study to assess the association between age-related macular degeneration and smoking in the elderly population. This study revealed significant relationship ($p < 0.001$) between age-related macular degeneration and smoking (Rasoulinejad et al., 2015). Myopia was mainly prevalent in children. Nucci et al. (2016) conducted a study to define risk factors associated with myopia in children, aged 5-16 years, of telecom employees in Italian regions. The researchers found significant associations between myopia and age, family history, sex, keratoconus, and hypertension (Nucci et al., 2016).

Visual impairment was a major concern because it impacts many individuals worldwide. Glaucoma, cataracts, and macular degeneration were common eye disorders that could affect all age groups and could impact vision significantly. Vision impairment could create issues such as the inability to walk, balance, and drive. Family’s budget could increase for the management of eye diseases because of the slow progression of glaucoma, cataracts, and macular degeneration (Eichenbaum, 2012). Eye diseases could interfere with daily life activities due to low vision or blindness. To address this further, some researchers suggested conducting research via surveillance activities so that eye disease, associated risk factors, and understanding can be developed further (Qiu, Wang, Singh, & Lin, 2013).

Vision Impairment Prevalence

The World Health Organization adopted a world action plan to reduce blindness by the year 2020 (Ramke, Zwi, Palagyi, Blignault, & Gilbert, 2015). In this plan, the World Health Organization announced that even though prevalence of blindness was reduced between 1990 and 2010 globally, prevalence stayed 15 times higher in the West African region (Ramke et al., 2015). The results of this study revealed that overall vision impairment prevalence has dropped worldwide but in certain developing countries, vision impairment still pose high risk. It is also difficult to estimate accurately the prevalence of vision impairment worldwide because of ongoing immigration of people around the world. Stevens et al. (2013) stated that, even though vision impairment is the leading cause of disability worldwide, it is difficult to detect the trend. Stevens et al. estimated that prevalence of vision impairment and blindness in the world from 1990 to 2010 will be 32.4 million (95% confidence interval [CI], 29.4-36.5 million; 60% women). The results of this study revealed a high rate of blindness in women globally in 2010. Despite of challenges to estimate accurate rate of vision impairment globally, the literature review indicated that the populations of some developing countries are at high risk for vision impairment and that the disease is more prevalent in women than men.

In the United States, vision impairment is also concerning health problem. In the United States, immigration is a major factor in vision impairment prevalence. To assess the disparities related to vision impairment in the United States, a cross-sectional study was conducted using the data from the 2003-2008 National Health and Nutrition Examination Survey (Wilson et al., 2014). The study results revealed significant differences in vision impairment between U.S. natives and noncitizens: the odds of legal blindness in noncitizens was up to 3.5 times than U.S. natives (95% CI 1.52-7.83).

Vision Impairment Prevalence in Asians

The prevalence of vision impairment in Asians as compared to the other racial groups is described in this section based on peer-reviewed literature. It was important to differentiate prevalence of vision impairment in Asian communities so that Asians at high risk for eye disorders could be assessed further. Premature blindness due to various eye diseases in Asians has been emphasized by a number of researchers. For example, Chan, Teo, and Cheung (2016) reviewed risk factors associated with myopia because the prevalence of myopia was high in Asian countries. These investigators found that the pathology of myopia was the most common cause of myopic choroidal neovascularization especially among patients less than 50 years of age but also that 89% of patients had vision impairment within only 5 years of diagnosis (Chan et al., 2016). Some studies estimated vision loss in Asian countries. Wong et al. (2014) estimated prevalence of vision impairment and blindness cases in East Asia between 1990 and 2010 via population-based studies. They found that age related blindness was 0.7% (95% CI 0.6 to 0.9) in 1990 and 0.4% (95% CI 0.3 to 0.5) in 2010 in East Asia, indicating a reduction in the prevalence of blindness in East Asia (Wong et al., 2014). Another study compared prevalence of vision impairment in Asian and non-Hispanic white preschool children. Tarczy-Hornoch et al. (2013) provided results of their cross-sectional, population-based study to compare vision impairment among Asian and non-Hispanic White preschool children. These investigators found that prevalence and causes of decreased visual acuity were related to refractive error and that this decreased visual acuity was found in Asian children as compared to the non-Hispanic White children (Tarczy-Hornoch et al., 2013). Varma, Hsu, Wang, Torres, and Azen's (2013) study also indicated a high rate of ocular diseases in Asians as compared to the other racial groups. The objective of the study was to provide information regarding risk factors related to eye diseases in Asian communities because by providing such information, eye health can be improved among Asians, who are one of the fast-growing communities in United States (Varma et al., 2013).

Education Level and Vision Impairment

Health literacy is important because understanding of health could help to acquire care and attention when needed. Elwood (2016) described health literacy as an important factor and health literacy can advance knowledge and understanding which can help with the maintenance of health and well-being. Education can be helpful in advancement of health literacy. In order to assess relationship between education level and eye disorders in Chinese population, Xu, Wang, and Jonas (2010) conducted a population based study. In this study, authors found that higher level of education was associated with lower prevalence for cataract and angle-closure glaucoma. Leider, Harper, Bharthapudi, and Castrucci (2015) conducted public health study using web-based survey and random sampling to assess educational attainment. Leider et al. (2015) found that information about level of education such as high school, bachelors, masters and doctorate can be helpful when designing public health interventions. Education can be helpful to improve healthcare knowledge. Per Green and Cavanaugh (2015), education is important to understand what is going on with the health and low levels of education can hinder anyone to receive proper health care because they lack the knowledge. Educational attainment improved health care knowledge and thus health improves. In the population-based study by Chen, Hahn, and Sloan (2016), they found that people who were 70 years of age and over and had higher education, they had better vision. English as a second language and not spoken frequently in the house can impact the way an individual receives healthcare. Jacobson et al. (2016) stated that the factor such as English as a second language and is not spoken in the house frequently may impact understanding of the disease and when to seek treatment.

SES and Eye Care

SES can dictate the way an individual receives care. SES such as unemployment can impact health. Glaucoma educational program conducted in the community resulted with the findings of unemployed individuals having less improvement in glaucoma knowledge (Rhodes et al., 2016). Similarly, another study found that communities with higher income had low late presentation of glaucoma but communities with low income had high late presentation of glaucoma (Buys & Jin, 2013). Similarly, Shweikh et al. (2015) found that risk for glaucoma was high among those of lowest income, and no evidence of threshold effect. SES has an impact on eye health. To assess the sociodemographic lifestyle, and medical risk factors associated with visual impairment in urban Asian population, authors conducted cross-sectional, population-based study (Chong et al., 2009). In this study, authors found that old age, lack of formal education, and unemployment as significant factors associated with poor vision among Asians.

Health literacy is an important aspect of SES. Vision health disparities in the United States were studied in which need for educational and innovative interventions were suggested for socioeconomically disadvantaged people (Zhang et al. 2012). Per Muir, Christensen, and Bosworth (2013), health literacy can impact poor vision so attention to health literacy can improve the eye care and vision outcomes in patients.

Vision Health Awareness

Vision health intervention programs are important because they spread awareness in the society. Government insurances are valuable resources for the healthcare for people in United States and because of these insurance options, eye disease prevalence were improved (Chan, Tope, Badley, Buys, & Jin, 2014). Public health educational campaigns were found to be successful in spreading awareness about vision health and for most of these campaigns; radio was a successful resource (Baker & Murdoch, 2008). Lack of awareness about eye diseases can create severe consequences with the vision and therefore awareness programs are necessary in communities (Nageeb & Kulkarni, 2015). Despite understanding of some common factors such as high intra-ocular pressure for glaucoma detection being a primary cause of the eye disease, detection of at risk population is equally important to distinguish so that educational programs can be implemented to help spread knowledge about risks associated with the eye disease in such communities (Crabb, 2016). Eye health awareness can reduce risks and help detect symptoms earlier in time. Low SES is one of the factors that can impact eye disease prevalence and hinders people from receiving proper health care, and so the educational programs tailored to spread awareness can improve the rate of eye diseases (Ko, Hwang, Chen, Lee, & Liu, 2016).

Geographical Distribution of Vision Impairment Cases in United States

The cases of vision impairment in United States vary. Already mentioned above, United States is land of immigration. Due to ongoing immigration in this country, it is difficult to be certain about the results of geographical distribution of vision impairment cases in United States. However, in this study, I have attempted to know if one location has high number of cases for vision impairment than the other. The vision impairment prevalence has increased in United States and to assess the demographic distribution of vision impairment within the country, Varma et al. (2016) provided results of six population based studies. The results of these studies influenced projection for high prevalence for vision impairment by year 2050 in which high projection can be in Florida State with 3.98%, Hawaii with 3.93%, Mississipi with 1.25%, and Louisiana with 1.20%. The results from this study indicated that South part of United States can be at high risk for prevalence for vision impairment as compared to the North. Glaucoma is a significant cause of vision impairment. Elam, Blachey, and Stein (2016) presented geographical variation for newly diagnosed open-angle glaucoma cases in United States from 2001 to 2014. In this retrospective cohort study, authors found that glaucoma was highly prevalent in Pennsylvania at 95%, South Carolina at 85%, in Texas at 57%, in Minnesota at 51%, and only 3% in Fresno, California. This study indicated varied results for glaucoma diagnosis in different states of United States. Even within the states, these results were a little different. For example, glaucoma diagnosis ranged from 0% in

Binghamton, New York to 35% in other parts of New York (Elam et al., 2016). Eye diseases are important part of the health care management. The eye diseases are unevenly distributed throughout the world and nationally. This may be due to ongoing immigrations of people and one community being susceptible to eye diseases then the other. It was difficult to know based on the varied results about geographical distribution of eye diseases and blindness but we have attempted to find trends of eye diseases based on this literature review. In this study, we hoped to provide information about eye diseases characteristics, diagnosis, and common trends which could help us understand them better and we can try to prevent premature vision impairment in high prevalence communities.

Chapter 3: Research Design and Method

Introduction

The purpose of this study was to evaluate the relationship between the level of education, geographical locations or both factors and vision impairment among Asians living in the United States. I employed a quantitative research methodology, which would allow for an objective assessment of possible differences between the level of education, geographical distributions, or both and the prevalence of vision impairment. I analyzed the collected data using the logistic regression statistical approach to assess associations and differences of the effects of the specified predictor variables (education level or geographical residential location) on visual impairment prevalence among the Asian-Americans or Asian communities.

Research Design and Rationale

The research design for this study was a cross-sectional study. A cross-sectional study was a type of observational study intended for use in the analysis of data from a population that is derived at a specific point in time (Creswell, 2009, Frankfort-Nachmias, & Nachmias, 2008). A cross-sectional design enabled the comparison of the prevalence estimation of vision impairment among the Asian population within the specified four geographical regions (north, south, east and west) of the United States. Similarly, it was also a good fit for assessing the association between the prevalence of vision impairment and the specified four education levels (high school, bachelor, masters, and advanced degree).

A cross-sectional study was best fit for this study because the primary objective posed in the research questions was to assess the prevalence of vision impairment given the exposure to either educational level attainment or geographical residential region or both. A cross-sectional study design was commonly known as a prevalence study (Creswell, 2009). Therefore, a cross-sectional design was the best choice for this study. Also, one of the primary reasons I preferred a cross-sectional design in the study was that all of the secondary data measurements were generated using a cross-sectional study design, which by default fulfills the need for a cross-sectional study design in this study. A drawback of using a cross-sectional study design was that I could only draw a correlational inference but not a casual inference (see Creswell, 2009).

Overall, the primary quantifiable variables implicated in this study were geographical residential locations, ethnicity/race, education level, and vision impairment. The independent variables were geographical location and educational level. The dependent variable was vision impairment. The primary unit of analysis was Asians (the ethnicity or race), which only included the target population living in the United States.

Data Source and Variables

The data for this study came from the U.S. Census Bureau and included 3,916,947 participants, based on the survey responses from 5 years from 2011 to 2015 (United States Census Bureau, 2016). The dataset included variables required to address the posed research questions. The dependent variable was vision impairment. The independent variables were the education level attained and geographical residential locations. In addition, I also accounted for the effects of the relevant confounding variables. The confounding variables or covariates were described in detail in the next paragraph.

The secondary dataset included information on blindness by geographical locations and blindness by educational attainments. The U.S. Census Bureau was a governmental organization that provided high-quality data on the population health characteristics and economic status of the nation for researchers and the public (United States Census Bureau, 2016). The data provided by the Bureau included information regarding disabilities related to vision, such as blindness, racial groups impacted by this disability, language spoken at home, years living in the United States, citizenship, place of birth, veteran status, educational attainment, school enrollment, marital status, grandparents, fertility, relationship, and household by type (United States Census Bureau, 2016). Nevertheless, I only used information needed to address the posed research questions. The dataset provided by the U.S. Census Bureau was massive and contained measurements of many health indicators and risk factors. It also contained information on the primary variables (vision impairment, geographical location, and educational attainment) for this study.

Methodology

The relevant test variables implicated in this study to address the posed research questions were vision impairment (the dependent variable) and education level and geographic location of residence (the independent variables). The data included information from a 5-year survey from 2011 to 2015 with 3,916,947 participants (United States Census Bureau, 2016). The data for this study were collected from the U.S.

population survey, and based on the survey questions and responses, I was able to compare the prevalence rate of participants with vision impairment who had a high school, bachelors, masters, and advanced degrees. The survey questions included how many persons had a disability involving vision loss and how many participants in the north, south, east, and west regions of the United States had vision impairment. For the independent variable construct, the education level had four categories (no school, high school, college, and advanced degree groups). A similar comparison between vision impairment and geographical residential regions was made as well. Estimation of differences in the prevalence of vision impairment of the target population was assessed based on the four geographical regions: the east, west, north, and south residential regions of the United States reported in the survey. The vision impairment data were based on the information on the partial or full blindness reported by an individual due to eye diseases such as myopia, macular degeneration, glaucoma, cataracts, and diabetic retinopathy (Bourne et al., 2016).

Age and sex were commonly known confounders. Mediating and moderating variables help researchers identify the attributable strength of the primary independent variables after accounting for a mediating and moderating effects of other variables (Creswell, 2009). Accounting for the mediating and moderating effects also allowed for a more accurate explanation of the relationship between geographical location or level of education and vision impairment, if any exist. A confounder variable interacted with both the risk factor and the health outcome, whereas a covariate only interacted with the health outcome in question (Creswell, 2009).

Possible confounding variables implicated in this study are age, sex, occupation, income, and living situation (owning a house or renting, living with family or living alone). The confounding variables were adjusted in the analysis because they could influence the magnitude of the outcome, creating biased or distorted information in the analysis (Creswell, 2009). Therefore, the confounders—age, sex, occupation, income, and the living situation—could influence the effects of vision impairment in the presence of the primary independent variables in the study. Hence, these confounders/covariates or mediators/moderators was adjusted in the statistical analysis.

Covariate variables that could influence the true effect of the independent variables in this study were owning a house versus renting a house and living with the family versus living alone. Not all covariates were confounders, but all confounders were inherently covariates (Creswell, 2009). In this study, because the variables of age, sex, occupation, and income were confounders, they were inherently covariates. These variables could have a direct influence on the outcome (vision impairment). The influence of these covariates/confounders could be a moderating or mediating effect in the presence or absence of the primary independent variables (geographical location and educational attainment).

The possible confounding variables was adjusted in this study, otherwise the outcome of the study could be distorted due to the true effect of the primary independent variables. To control such confounding to avoid gross distortion of the primary IVs' effects on the primary outcome, using a logistic regression model, I conducted a series of stratification manipulations of the confounders/covariates in the statistical analysis to minimize the chances of a Type I or Type II error. It is important to control confounding effects in a study otherwise the true effect of the outcome in the presence of the primary IVs would be distorted (Nam, Henderson, Rohan, Woo, & Russek-Cohen, 2017).

Population

The target population in this study was Asians between the ages of 18 to 90 living in the United States. The study used pre-existing data from the United States Census Bureau and provided by the Centers for Disease Control and Prevention (CDC). The study inclusion/ exclusion criteria for the participants included the following:

The inclusion criteria:

1. Must be between age from 18 to 90
2. Diagnosis of vision impairment
3. Living in United States
4. Gender
5. Race

Exclusion criteria:

1. Below high school degree level
2. Not living in United States
3. Familiar history of vision impairment (if applicable/known)

Participants were stratified by age groups to avoid the confounding effects of age. Other covariates were adjusted similarly. The ages group set up for the study were 18-25, 26-33, 34-41, 42- 49, 50- 57, 58 and above. The stratification of the participants by age group helped in exploring whether age had a substantial effect on vision impairment, enough to distort the true effects of the primary independent variable. The stratification assessment of the age groups was evaluated separately for both geographical regions and levels of education. Individuals with an education level below the high school level were excluded from the study primarily because the secondary dataset used in this study did not contain education information on people with education status below the high school level. People not living in the United States were also be excluded from the study because only participants living in the United States were interviewed in the survey. Participants' race (Asian) were among the inclusion criteria, but other race groups were excluded from the study's analysis. All gender (male and female) in the Asian target population were included in the data analysis.

The random sampling method was used in this study. Random sampling allowed the flexibility of arbitrary selection of samples from the dataset. Random sampling was critical because it helped in reducing the chances of systematic error, bias, spurious error, and internal/external validity issues (Creswell, 2009, Frankfort-Nachmias, & Nachmias, 2008). Also, random sampling could substantially minimize the effects of selection bias in a study.

Questionnaire Procedures

The data used in this study was generated by the Centers for Disease Control and Prevention (CDC) and the United States Census Bureau (Kirtland et al., 2015). The data was generated via a survey method administered by the United States Census Bureau (Kirtland et al., 2015). The survey included in the secondary data were from the 2011 to

2015 period, which involved survey on 3,91,6947 subjects in the United States on vision loss and educational attainments (Kirtland et al., 2015).

The U.S. Census Bureau is part of United States Department of Commerce. They are responsible in maintaining information relating to the economics and population statistics on key national health and social indicators (Kirtland et al., 2015). The Census Bureau conducts surveys in population and provides high quality data for research innovations. The information provided in the secondary data report was useful in evaluating the incidence or prevalence rates of individuals with vision loss who were living in different parts of the U.S. regions. The secondary data in question also contained quantitative information on individuals with vision problems and their educational attainment. The secondary dataset was an open source data (Kirtland et al., 2015). The data was available/accessible in a public domain server, and was developed for research purposes (Kirtland et al., 2015).

The U.S. Census Bureau conducted more than 130 surveys each year that includes household survey, community survey, and business survey (United States Census Bureau, 2016). These surveys were conducted periodically to maintain current and up-to-date data and information on the health, social, and economic indicators (United States Census Bureau, 2016). The surveys were conducted via online/internet, mail, phone, and in-person methods (United States Census Bureau, 2016). The largest surveys were the household surveys (United States Census Bureau, 2016). In these surveys, the U.S. Census Bureau representatives contacted household members to obtain information related to age, education, housing, and income (United States Census Bureau, 2016).

Sampling and Sampling Procedure for the CDC Data

Kirtland et al. (2015) used random sampling where they obtained country level estimates of severe vision loss (SVL) and compared it with poverty level among adults aged >18 years and their geographical distributions from 2009 to 2013. This information was provided by the U.S. Census Bureau. Kirtland et al. (2015) also stated that with the application of stratified random sampling, they divided 3,143 counties based on the proportion of residents living below poverty level. A similar sampling approach was used in this study. The data was stratified and randomly selected for the statistical analysis.

The Dissertation Sampling and Sampling Procedures

The sample size calculation was based on the estimation of individuals at risk or vulnerable to vision impairment and the estimation of individuals living in different geographical locations- the north, south, east and west. Similarly, the sample size was selected based on educational attainments criteria. The statistical power selected in the analysis was set at 0.8 (80%) and the confidence level was set at 0.95 (95%). G*power software was used in estimating the accurate sample size needed for the study. With the anticipation of having an effect size (using an odd ratio) value of 1.3, the minimum total sample size required to observed an odds ratio of 1.3 in this study was 721 samples. The estimated sample size of 721 participants was used for the evaluation of the association between educational levels (high school, college, and advanced degree) and vision impairment. Similarly, 721 participants were also used for the assessment of the difference in the prevalence of vision impairment and the geographical residential location (the north, south east, and west). More importantly, the 721 participants were selected at random from the secondary data information. Also, I applied the sample proportion selection approach to ensure that equal or at least close to equal participant based on gender, age, education level, geographical location, income level and occupation type were represented proportionally in the study.

Power Calculation for Logistic Regression

Based on the posed research question integrity, the study was an inferential study. An alpha value of 0.05 was used as the predetermined type I error limited to determine the statistical or non-statistical basis of the study for both research questions. The selection of alpha level was important and must be determined the baseline to either reject or not reject the null hypothesis. Normally, the alpha level was either 0.05 or 0.01 in most research studies (Suresh & Chandrasekhara, 2012). However, in this study, the predetermined alpha level of 0.05 was used. Using a logistic regression approach with an odds ratio (effect size) of 1.3, the total sample size required for this study using an alpha value of 0.05 and 0.80 power was 721. See the table and figures below for more information.

Table 1

Protocol of power analysis

	Description	
z tests	logistic regression	
Options	Large sample z-test, demidenko (2007) with var corr	
Analysis	A priori: Compute required sample size	
Input	Tail(s)	Two
	Odds ratio	1.3
	Pr(Y=1/X=1)H0	0.2
	α err prob	0.05
	Power (1-β err prob)	0.80
	R^2 other X	0
	X distribution	Normal
	X parm μ	0
	X parm σ	1
Output	Critical z	1.9599640
	Total sample size	**721**
	Actual power	0.8001115

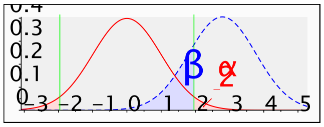

Figure 1. Central and Non-central Distributions.

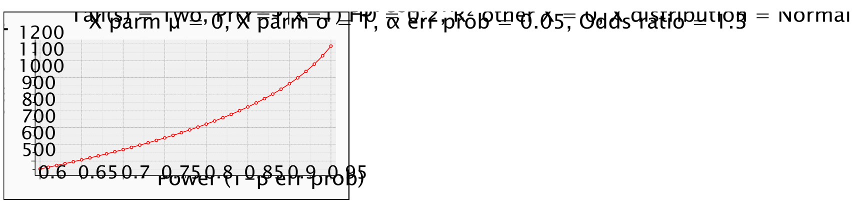

Figure 2. G*Power Plot for sample size estimation.

The sample size also reflected groups living in the specified four geographical locations, the north, south, east and west of the United States. Similarly, the estimation of the sample size using the G*power estimation software accounted the four education levels (high school, college, and advanced degree). The statistical power selected for the sample size estimation, which was 0.8 (80%) was enough to minimize the chances of a type II error.

Data Analysis Plan

In this study, the data was analyzed using the statistical package for social sciences (SPSS) statistical software. This software was commonly used in research studies, particularly in social science analysis. The statistical analytical method used in this study was a logistic regression. The logistic regression is a statistical technique that could be used when the dependent variable was categorical or nominal and the independent variable is either a categorical/nominal or continuous variable (Creswell, 2009). This technique helped in assessing vision impairment prevalence by geographical locations and level of education. The dependent variable in the study was vision impairment prevalence which was a categorical variable, and therefore, the application of a logistic regression was appropriate. This technique was helpful in the assessment of the relationship between vision impairment with the level of education and geographical locations.

Both Inferential and descriptive statistics assessments was applied in the study. In this study, the inferential statistics was used to evaluate the correlational basis between the IVs and the DV. On other hand, the application of the descriptive statistics was used to describe the relevant data/variable distribution or pattern of distribution. The covariates and confounders were evaluated using both a descriptive (e.g bar charts or graphs or tables) and inferential statistics (e.g statistical significance and effect size estimation). For example, a stratified age groups were analyzed and described using the descriptive statistics.

Statistical Analysis

There were two inferential research questions posed in this study. Both inferential research questions could be analyzed using a logistic regression statistical approach. The logistic regression was a statistical technique that could be used when the levels of measurement for a dependent variable (DV) was a nominal level of measurement or a categorical variable and when the independent variable (IV) was either a quantitative or categorical variable (Creswell, 2009). This technique was useful in the evaluation of the relationship of vision impairment prevalence by geographical locations and level of education, because both the DV and the IVs were categorical variables. Individuals with vision impairment was categorized/grouped as either as individuals with a vision impairment or individuals with no vision impairment. Therefore, the application of a logistic regression statistical approach was a very useful in assessing the relationship between vision impairment and education levels or geographical residential locations of the Asian target population in this study.

The first research question involved with the assessment of the association between vision impairment and level of education. As much, the second research question involved with the assessment of the difference in the prevalence of vision impairment among Asian population and their geographical residential locations. In either case, the application of a quantitative research method was the best research method that aligned with the objectiveness of the research questions' constructs. Therefore, a quantitative method was used in this study because it was a useful objective approach that could allow the analysis of the differences in the prevalence of the vision impairment among different geographical residential locations or the differences in the prevalence of the vision impairment and level of education. Also, the statistical assumptions of normal distribution of the data was assessed using a histogram curve or a normality distribution test.

Research Questions

RQ1: Were there associations between vision impairment prevalence and level of education (no school, high school, college, and advanced degree)?

H_{01}: There were no associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence

Ha_1: There were associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

RQ2: Were there differences in the prevalence of vision impairment among Asian-Americans based on the geographical locations of residence (east, west, north, and south)?

H_{02}: There were no differences between geographical locations (east, west, north, and south) and vision impairment prevalence

H_{a2}: There were differences between geographical locations (east, west, north, and south) and vision impairment prevalence.

Threats to Validity

Establishing both internal and external validity in any study was very important for many reasons. It allowed the researcher to make claims that were reproducible and reliable. Internal validity occurred when the effect of observation for an independent variable on dependent variable were mainly based on the direct interactive effects of the two variables but not influenced mostly by any external sources. External validity was the optimization that the results of the study could also benefit other groups other than the current group within the study or that the effects observed may not be limited to the studied group. As much, the potential threat to validity in this study were described as follows: There could be a possibility of selection bias in this study due to the survey method used for the data collection. The possible selection bias in this study could be related to the selection of data from only Asian Americans.

The data source was credible but with any research, establishing optimization of credibility was important. Hence, I evaluated the data source codebook during the data analysis phase of the study. Some factors that could influence the internal and external validity in this study were recall, responders, interviewers, and misclassification biases. The threat to the external validity in this study was the lack of the ability to advance generalization. Variable interactions could distort the true attributable effects of the IVs. For instance, if interaction existed between age and vison impairment and if interaction also existed between gender and vision impairment, then any assessment of the participants' geographical residential location or level of education's effects on vision impairment without considering the age and gender effects by stratification distorted the true effect of geographical residential location and level of education attainment on vision impairment.

Therefore, it was important to understand and minimize/reduce the chances of incurring internal and external validity issues. The subjects' selection process was randomized. However, the assignment of subjects to the exposure or risk factors (geographical residential regions and education level) were not randomly assigned. Therefore, lack of random assignment could pose substantial risk to internal and external validity in the study. However, the application of appropriate corrective measures in the statistical approach such as the propensity score matching, stratification, proportional distribution, etc., could help minimize the chances of internal and external validity issues (Schuetz & Wahl, 2017). Therefore, in this study, I applied propensity score matching, stratification, and proportional distribution strategies in the sample selection processes and statistical analysis of the dataset.

Quality in large datasets had been a concern for researchers because incorrect or inconsistent data could alter the study results (Hellerstein, 2008). To increase the odds of error-free data in a quantitative study, identification of outliers and exploratory data analysis had been found successful (Hellerstein, 2008). In addition, threat to validity could be substantially minimized through the application of appropriate measurement tools, statistical approaches, and advancement of evidence-based informed research practice and procedures.

Ethical Procedures

The approval process for this study was evaluated by the Walden's University Research Review (URR) team and the university Institutional Review Board (IRB). The application process to seek the IRB approval for this study was completed once the URR team approved the first three chapters (1, 2, and 3) of the research proposal. With an IRB approval, I requested access and permission for the secondary data and upon reception of dataset, I began the data analysis of the chapter 4 proposal. There were no major ethical concerns with the process of this study. This study was based on observational model where pre-collected de-identified survey data was used. However, the study must be conducted based on the Walden university ethical guidelines and the U.S. code of federal regulation on study involving human subjects or human subjects' personal health information. In summary, the research design and methodology employed in this study were fitting and sufficient in addressing the posed research questions. Possible validity and ethical issues were addressed appropriately to minimize the chances of incurring spurious findings.

Summary

As described above, the purpose of the study was to assess the associations of level of education, geographical locations and vision impairment among Asians living in the United States. A cross-sectional design was used in the study. The data was sourced from the U.S. Census Bureau. The dependent, independent, confounding, and covariates were included into the statistical analysis model of logistic regression. The data was analyzed using the SPSS statistical software and using the logistic regression model. The sample size was determined using the G*Power analysis and the samples/participants were selected randomly from the secondary data. Variables were measured and analyzed using descriptive and inferential statistics. Confounding and covariates were stratified and analyzed with both the descriptive and inferential statistics. Any possible bias and threat to validity in the study were minimized using the appropriate corrective statistical methods and evidence based practice.

Chapter 4: Results

Introduction

The purpose of the study was to assess the association between vision impairment and education level and between vision impairment and geographical location. The cross-sectional research design applied in this study was not intended for a causal inference. However, the cross-sectional nature of the study helped in promoting better health measures on the correlation effects of modifiable and nonmodifiable risk factors (educational level and geographical location) on vision impairments among Asians. The following questions were the basis of the research inquiry addressed in this study.

RQ1: Were there associations between vision impairment prevalence and level of education (no school, high school, college, and advanced degree)?

RQ2: Were there differences in the prevalence of vision impairment among Asian-Americans based on the geographical locations of residence (east, west, north, and south).

To assess the inferential meaningfulness of the above posed research questions, the following corresponding hypotheses were explored as well. The proposed null hypotheses were rejected or not rejected based on the estimated p-value for each research question.

H_{01}: There were no associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

Ha_1: There were associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

H_{02}: There were no differences between geographical locations (east, west, north, and south) and vision impairment prevalence.

H_{a2}: There were differences between geographical locations (east, west, north, and south) and vision impairment prevalence.

Data Collection

I applied a cross-sectional approach in this study because that was the research design used by the primary data source. In other words, the secondary data measures I analyzed were originally gathered through a cross-sectional approach. A cross-sectional approach was the best design for assessing the prevalence rate of an even or outcome (Creswell, 2009). The secondary data used for the purpose of the study contained the required dependent and independent variables stated in the research questions (United States Census Bureau, 2016). The U.S. Census Bureau (2016) used a survey for the data collection. I received data from-the U.S. Census Bureau public domain (United States Census Bureau, 2016). About 3,916,947 subjects participated in the survey between 2011 to 2015, and random sampling technique was used in selecting qualified participants (United States Census Bureau, 2016). The sample size estimation for this study analysis was calculated with the G*Power software (Walden University, 2018). There were two categories of vision impairment (yes or no to vision impairment), four levels for the geographical locations (east, west, north, and south) and four educational attainment levels (no school, high school, college, and advanced degree), which were elements I considered in the estimation of the required minimum sample size to attain a statistical power of 80%.

The U.S. Census Bureau conducts surveys periodically to provide critical support for governmental programs, policies, and decision-making processes (United States Census Bureau, 2016). Participation was voluntary and included individuals living throughout the United States (United States Census Bureau, 2016). The dataset is available and accessible to the public. It contained information about not only the primary variables but also the identified confounders in this study.

The secondary dataset sample population is massive with sufficient participants to fulfil the minimum sample size required for this study. In this study, 721 participants were the minimum sample size estimated to achieve a statistical power of 80%. However, a total of 129,252 Asian participants were used in the data analysis because a substantial increase in the sample size would minimize the chances of any potential Type 1 or Type 2 error in the analysis. Table 2 represents descriptive and demographic characteristics of the sample population. These descriptive counts were performed with a sample population of 3,916,947 participants.

Table 1

Baseline Descriptive and Demographic Characteristics of the Sample Population

	All other races	Only Asians	Total
Number of participants	3787695	129252	3916947
Age category			
Between 18 to 25	86283	3514	89797
26 to 33	86283	3514	89797
34 to 41	86283	3514	89797
42 to 49	86282	3514	89796
50 to 57	86282	3514	89796
58 and above	86282	3514	89796
Total	517695	21084	538779
Gender			
Male	315000	10542	325542
Female	315000	10542	325542
Total	630000	21084	651084
Geographical locations, Category			
East	340000	10771	350771
West	340000	10771	350771
North	340000	10771	350771
South	340000	10771	350771
Total	1360000	43084	1403084
Level of education, Category			
No school	320000	11000	331000
High school	320000	11000	331000
College	320000	11000	331000
Advanced degree	320000	11000	331000
Total	1280000	44000	1324000

Confounders

Age. In this study, age was a categorical variable and a confounder. The participants were categorized into six age groups. The participants were grouped into age categories as follows: 18 to 25, 26 to 33, 34 to 41, 42 to 49, 50 to 57, and ≥ 58 years old.

Gender. Distribution of participants by gender was important in controlling or minimizing gender-related confounder effects. Gender was a categorical variable. Both male and female participants were included in this study. The counts for gender proportion for both men and women participants were evenly distributed. I used random sampling method to select participants.

Independent Variables

Geographical locations. In this study, geographical locations were grouped into a categorical variable. The categories included four groups: east, west, north, and south. The sample population represented in each of this group was evenly distributed.

Level of education. The level of education was also a categorical variable. Education level included four categories: no school, high school, college, and advanced degree. The sample counts of participants based on their level of education were evenly distributed among all the selected four groups.

Sample estimation could provide accurate and meaningful information. Such estimation was meaningful if it provided information representative of the target population such that when possible, an accurate generalization could be made about that population for the exposure and outcome observed (Bornstein, Jager, & Putnick, 2013). Based on the research questions and purpose of the study, only the Asian population were selected for the inferential analysis to address the posed research questions. It was not appropriate to analyze every single data point (all the race groups) individually in the population. To avoid having errors and misleading information, a probability sampling approach was used. The probability sampling method allows random selection of samples in equal probability, which improves the internal and external validity of a study (Raina, 2015). Probability sampling is widely used technique for sample selection (Cresswell, 2009).

The specified covariates and confounders (age, sex, occupation, income, and living situation) interacted with vision impairment in the presence or absence of the primary independent variable (education levels and geographical locations). Living situation included owning a house or renting or living with family or living alone. The covariates and confounders were described descriptively using bar charts, graphs, and tables and also were analyzed inferentially by estimating the statistical significance and effect size estimation. Vision impairment among the selected population in this study was also stratified based on age groups. When covariate or confounding variables were not adjusted in any analysis the assessment of the effect of the primary dependent variable under investigation could be distorted in the analysis (Creswell, 2009). Therefore, the confounders-age, sex, occupation, income, and the living situation could influence the effects of vision impairment in the presence of the participants’ education level and geographical location or residential area. Hence, these confounders or covariates or mediators or moderators were adjusted in the statistical analysis.

Covariate variables could influence the true effect of education level (no school, high school, college, and advanced degree) and geographical location or residential area (east, west, north, and south) on vision impairment. Covariates are not necessarily confounders, but all confounders are inherently covariates, either way, they could influence the outcome (Creswell, 2009). For this study, age, sex, occupation, and income were confounders, therefore, they were inherently covariates. These variables could have a direct influence on the outcome (vision impairment) and the primary variables (education level, and geographical locations or residential area). The influence exerted by these confounders could be a moderating or mediating effect in the presence or absence of the primary independent variables (geographical location and educational attainment).

Results

Below was the frequency distribution of racial groups represented in the dataset. About 3.3% of total data represented Asian population in this study.

Table 2

Frequency Distribution of Sample Population by Race

Race	Frequency	Percent	Valid Percent	Cumulative Percent
White	3173243	81.0	81.0	81.0
Black	380553	9.7	9.7	90.7
American Indian	24416	.6	.6	91.4
Alaskan	503	.0	.0	91.4
Native American	5262	.1	.1	91.5
Asian	129252	3.3	3.3	94.8
Native Hawaiian	4326	.1	.1	94.9
Other Race Alone	104521	2.7	2.7	97.6
Two or More Races	94871	2.4	2.4	100.0
Total	3916947	100.0	100.0	

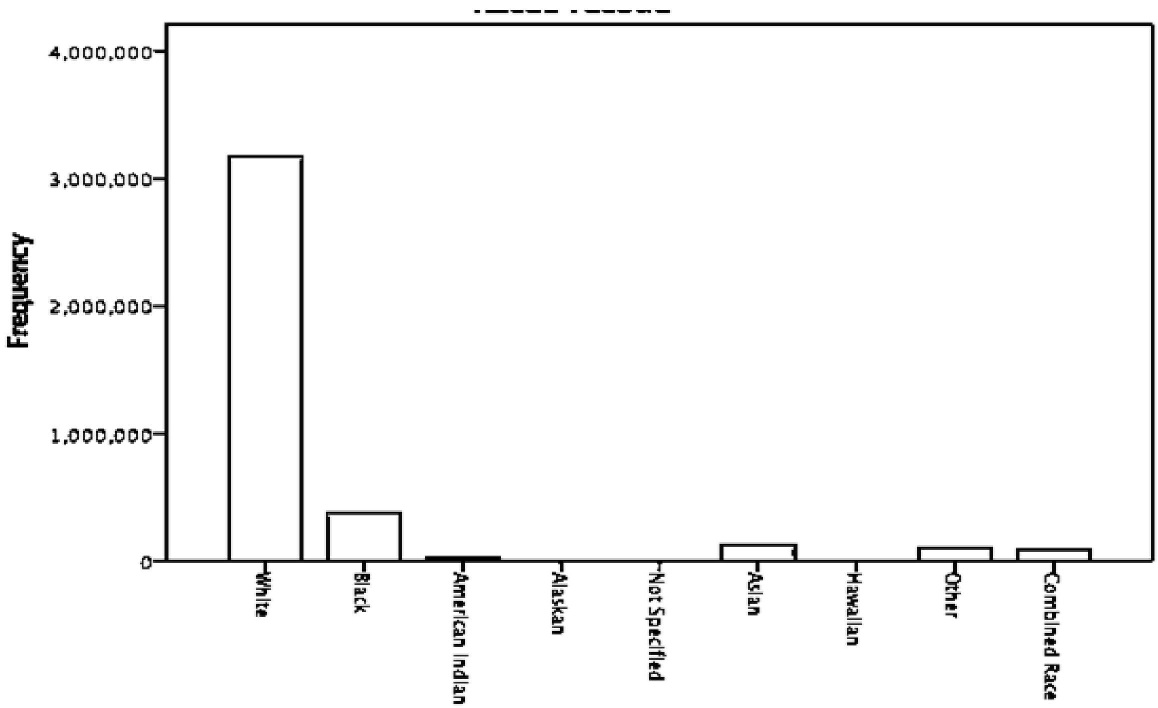

Figure 3. Frequency distribution of sample population by race.

Shown in Table 4 was the frequency distribution of vision impairments among the Asian population. About 1.3% of Asians represented in the data population had vision impairment and 98.7% of the population did not have vision impairment.

Table 3

Frequency distribution of sample population by vision impairments

Vision difficulty	Frequency	Percent	Valid percent	Cumulative percent
Yes	1654	1.3	1.3	1.3
No	123687	98.7	98.7	100.0
Total	125341	100.0	100.0	

Shown in Figure 4 was bar chart representing the frequency distribution of the Asian sample population. The graph represented the Asian population by the status of vision impairment.

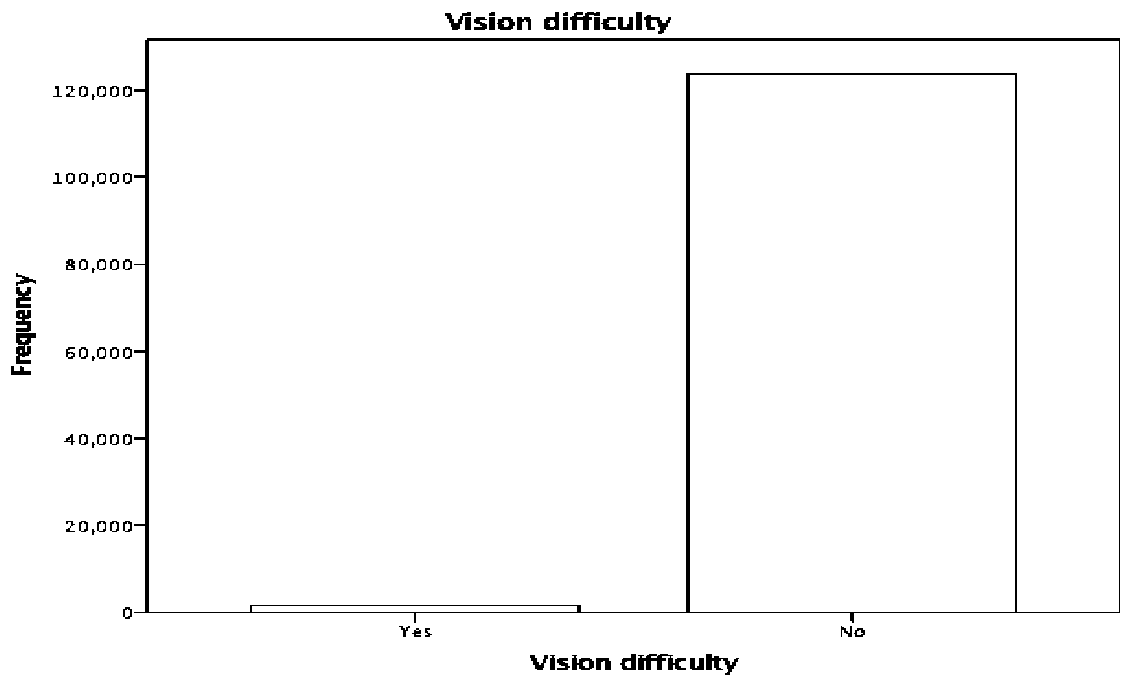

Figure 4. Frequency distribution of sample population by vision impairments.

Shown in Table 5 was the educational attainment (EDCAT) (no school, high school, college, and advanced degree) distribution. In this table, 8.7% Asian participants did not go to school (no school), 22.6% attended high school, 37.5% received college degree, and 31.1% participants had advanced degree.

Table 4

Frequency distribution of sample population by educational attainments

	EDCAT	Frequency	Percent	Valid percent	Cumulative percent
	No School	6172	4.9	8.7	8.7
	High School	15956	12.7	22.6	31.4
	College	26477	21.1	37.5	68.9
	Advanced Degrees	21969	17.5	31.1	100.0
	Total	70574	56.3	100.0	
Missing	System	54767	43.7		
Total		125341	100.0		

Shown in Figure 5 was the graphical representation of the proportion of Asians based on education attainment. The graphical display was scaled based on the frequency count.

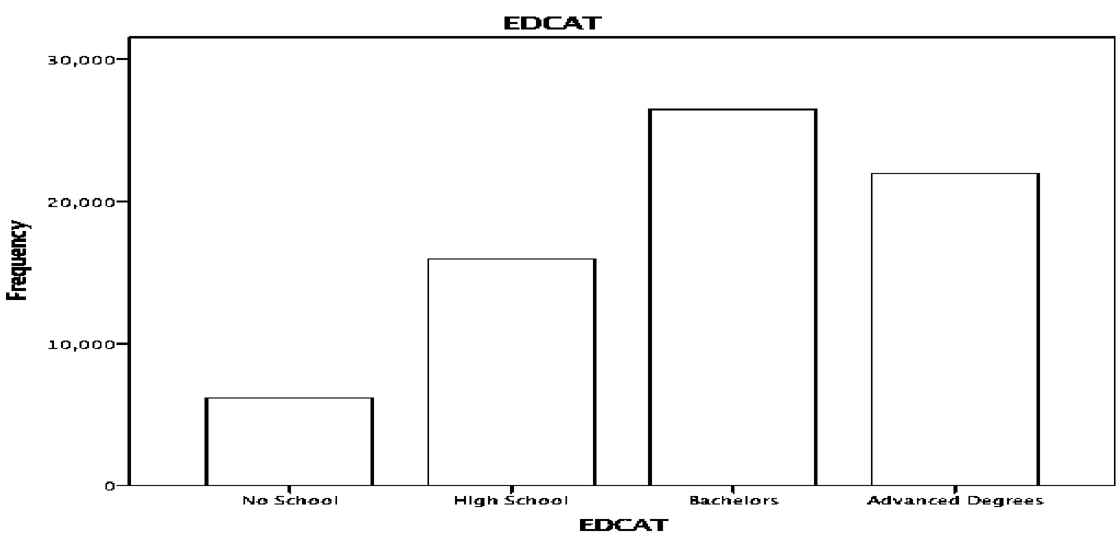

Figure 5. Frequency distribution of sample population by educational attainments.

Shown in Table 6 was the Frequency distribution of residential geographical locations (GeoLocat) (east, west, north, and south). Based on the information provided in the table, the distribution of the Asian participants' distribution mapping in terms of the location of their residence were 31.7%, 61.7%, 3.9%, and 2.7% in the east, west, north, and south part of the United States respectively.

Table 6

Frequency distribution of sample population by geographical locations

GeoLocat	Frequency	Percent	Valid percent	Cumulative percent
East	39690	31.7	31.7	31.7
West	77331	61.7	61.7	93.4
North	4947	3.9	3.9	97.3
South	3373	2.7	2.7	100.0
Total	125341	100.0	100.0	

Shown in Figure 6 was the graphical representation of the frequency distribution of the geographical locations of the Asian participants.

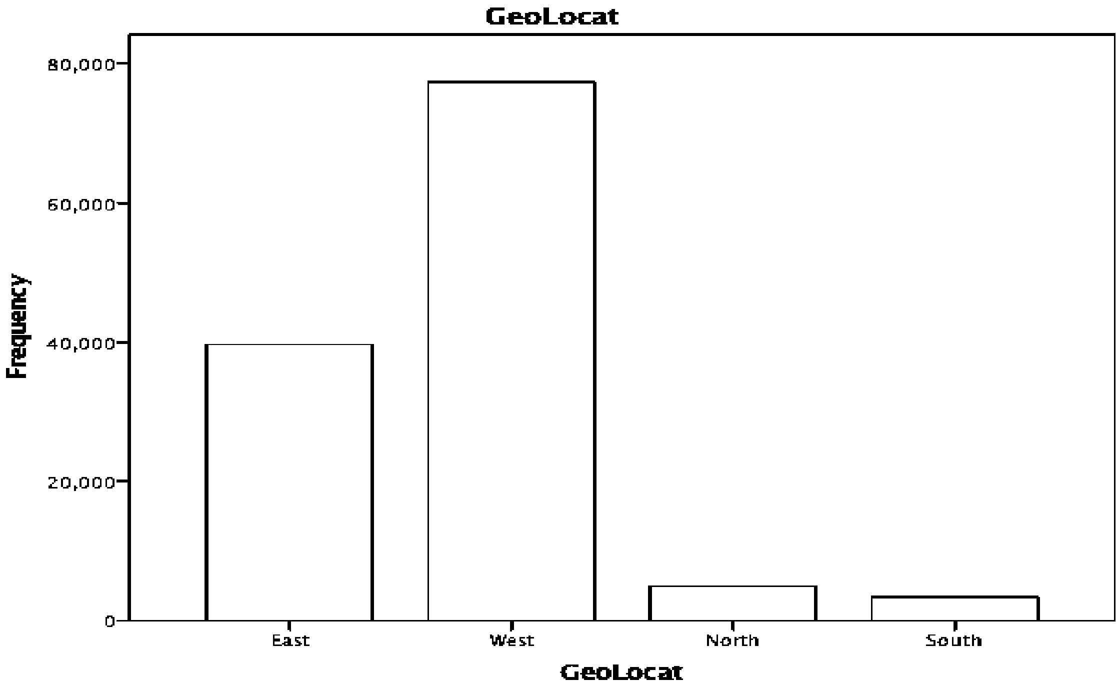

Figure 6. Frequency distribution of sample population by geographical locations.

Statistical Assumptions

The application of a logistic regression requires a set of assumptions to be met depending on the type of regression applied in an analysis. In general, the levels of measurements for the independent, dependent, covariate, confounder variables etc., must be considered before applying any type of logistic regression. The binary logistic regression criteria included an assumption that required ‘categorical’ level dependent variable, ‘quantitative and/or categorical’ independent variable, and two categories of the dependent variable (Creswell, 2009). The dependent variable in this study was vision impairment, and it was a nominal variable and mutually exclusive. It was categorized into ‘Yes’ for the presence of vision impairment outcome (coded as ‘1’ in the SPSS software) and ‘No’ for the absence of vision impairment outcome (coded as ‘2’ in the

SPSS software). In the logistic regression model, age and sex was stratified for the assessment of vision impairment. The variables age, sex, educational attainment, and geographical locations were independent of each other. Large dataset was used for the statistical analyses in this study, which was approximately 129,252 Asian participants.

Statistical Analysis

In this study, binary logistic regression was used in the statistical analysis. Sequential inclusion of variables in the logistic model were used. The primary independent variables (education levels and geographical locations) were first included and evaluated without including the age or sex or any other covariates. Finally, age and sex were then included in the model to assess any interaction effects. Also, the analysis was conducted with sex alone in the model.

Coding of the Categorical Variables for the Analysis

The categorical variables, educational attainments, geographical locations, age, and sex were coded as follows:

Educational Attainments,

Educationlevel = no school

Educationlevel (1) = high school

Educationlevel (2) = bachelors

Educationlevel (3) = advanced degree.

Geographical Locations,

Geolocation = east

Geolocation (1) = west

Geolocation (2) = north

Geolocation (3) = south

Age,

Age (1) = 18 to 25

Age (2) = 26 to 33

Age (3) = 34 to 41

Age (4) = 42 to 49

Age (5) = 50 to 57

Age (6) = 58 and above

Sex,

Sex (1) = Male

Sex (2) = Female

Logistic Regression Model: Assessment of the Relationship between Educational Attainment and Vision Impairment

The following logistic regression analysis provided results to address the posed research question and hypothesis:

RQ1: Was there an association between vision impairment prevalence and level of education (no school, high school, college, and advanced degree)?

H_{01}: There were no associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

Ha_1: There were associations between education levels (no school, high school, college, and advanced degree) and vision impairment prevalence.

Prediction on Education Level: **Assessment of primary and outcome variable**

In this analysis, only the education levels were added in the model shown in Table 7. The educational attainment (no school, high school, college, and advanced degrees) effects on vision impairment were evaluated. The explained variation in the vision impairment variable based on the model ranged from 0.5% to 4.3%. In other words, about 0.5% to 4.3% of vision impairment could be explained by educational attainment alone.

Table 5

Variance explained for educational attainment variable

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	9269.650[a]	.005	.043

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Shown in Table 8 was the category prediction table for education attainment and its effect on vision impairments with 'the cut value' set at 0.500, see bottom note of Table 8. It means that the probability of vision impairment in the data with the 'yes' category was greater than 0.500. This table also provided the percentage accuracy in the classification, sensitivity, specificity, positive predictive value, and negative predictive value. The percentage accuracy in classification reflected the cases that were correctly classified as 'no' for vision impairment when educational attainment was added in the model. The sensitivity was the percentage of cases that had the observed characteristics, that was, the 'yes' group for vision impairment. The specificity was the percentage of cases that did not have the observed characteristic, which was the 'no' group for vision impairment. The positive predictive value and negative predictive values were the percentages of correctly predicted cases with the observed characteristic compared to the total number of cases.

Table 6

Category prediction for educational attainment variable

			Predicted		
			Vision difficulty		
	Observed		Yes	No	Percentage Correct
Step 1	Vision difficulty	Yes	0	902	.0
		No	0	69672	100.0
	Overall Percentage				98.7

a. The cut value is .500

Variables in the Equation for Education Attainment

Shown in Table 9 was the variable in the equation for education attainment. In this Table, all the educations level (high school, college, and advanced degrees) were statistically significant when compared to the individuals without degree. The 'no school' category was statistically significant $W(3) = 366.606, p < 0.001$. Based on this information, the null hypothesis assertion that there was no association between education level (no school, high school, college, and advanced degree) and vision impairment prevalence) should be rejected.

The result for individuals with 'high school' showed the following estimations, $\beta = .354$, $W(1) = 15.445$, $OR = 1.425$, $p^{***} < 0.001$, *95% CI [1.194, 1.700]*. A *p*-value <0.*001* was less than 0.05, thus, suggesting that this category was significantly impacted by vision impairment. Similarly, odds ratio, $OR = 1.425$ (>1), also suggested that individuals with high school were 1.4 times more likely to have vision impairment than those without degree. The 'college' category result showed the following estimation, $\beta = 1.311$, $W(1) = 178.729$, $OR = 3.710$, $p^{***} < 0.001$, *95% CI [3.061, 4.497]*. The college level predicted vision impairment. In other words, individuals with 'college' degree were 4 times more likely to have vision impairment compared to those without degree.

The estimation for the 'advanced' degree group was shown as follows; $\beta = 1.830$, $W(1) = 238.975$, $OR = 6.233$, $p^{***} < 0.001$, *95% CI [4.942, 7.860]*. Based on these results, 'advanced' degree group predicted vision impairment. Individuals with advanced degrees were 6 times more likely to have vision impairment compared to individuals without degree. Based on table 9, the higher the education level, the risk of education impairment increases.

Table 7

Variable in the equation for educational attainment

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	No school			366.606	3	.000			
	High school	.354	.090	15.445	1	.000	1.425	1.194	1.700
	College	1.311	.098	178.729	1	.000	3.710	3.061	4.497
	Advanced degree	1.830	.118	238.975	1	.000	6.233	4.942	7.860
	Constant	3.417	.073	2216.309	1	.000	30.490		

a. Variable(s) entered on step 1: EducationLevel.

Age and Sex Variables included in the Model

In the analysis below, Table 10, was the model summary when age and sex variables were included in the assessments of the relationship between educational attainment and vision impairment. In this table, Cox and Snell R square model showed that only 1.1% of the vision impairment could be explained by educational attainment when age and gender effects were accounted for. In contrast, with the Nagelkerke R square model, 8.5% of the vision impairment outcomes could be explained by educational levels when age and gender were accounted for.

Table 8

Variance explained for educational attainment variable – age and sex included in the model

Step	-2 Log likelihood	Cox & Snell R square	Nagelkerke R square
1	8887.437[a]	.011	.085

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Category Prediction

Shown below, Table 11 was category prediction for educational attainment when age and sex variables were added in the model. From the results provided, 902 individuals predicted with having vision difficulty when age and sex were included in the assessments of educational attainment with vision impairments whereas 69672 individuals predicted not having vision difficulty when age and sex were included in the assessments of educational attainment with vision impairments.

Table 9

Category prediction for educational attainment, age, and sex variables

	Observed		Predicted vision difficulty		Percentage correct
			Yes	No	
Step 1	Vision difficulty	Yes	0	902	.0
		No	0	69672	100.0
	Overall percentage				98.7

a. The cut value is .500

Variables in the equation

Shown in Table 12 below was the variable in the equation for educational attainment after controlling for age and sex. The analysis on whether to reject or fail to reject the null hypothesis for the effects of education level while controlling for age and sex on vision impairment outcomes was evaluated. In Table 12, age and sex were confounders.

Wald was used in determining the statistical significance of educational attainment to vision impairment among the Asian population when age and sex was added to the model. In this model, educational attainment was categorized into four groups. The educational attainment categories were compared with the 'no school' category in the logistic regression model. Based on the model, education predicted vision impairment, $W(3) = 143.509, p <0.001$. Therefore, we rejected the null hypothesis. For the education category interactions, individuals with only 'high school' education showed a negative but a non-statically significant effect on vision impairment as shown in Table 12, $\beta = -0.126, W(1) = 1.828, OR = 0.882, p = 0.176$, *95% CI [0.735, 1.058]*. Based on this estimate the 'high school' group did not predict vision impairment. The rest of the education levels (bachelors' degree and advanced degree) showed statistically significant difference for vision impairment.

In the model shown in Table 12, gender did not predict vision impairment, $\beta = 0.006, W(1) = 0.009, OR = 1.006, p = 0.926$, *95% CI [0.880, 1.151]*. On the other and, age significantly predicted vision impairment, $W(5) = 357.078, p^{***} <0.001$. For all the age categories, there were statically significant effects on vision impairment. Therefore, we rejected the null hypothesis after controlling for age.

The magnitude of the effect for each of the variable analyzed in this study were represented by "*Exp(B)*", which the odds ratio (*OR*) in this analysis. Individuals in the age category 42 to 49 had the highest risk of vision impairment. This age group were 7 times more likely to have vision impairment compared to the 18 to 25 age group, see Table 12.

Table 10

Age and Sex variables in the equation for educational attainment variable

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	No school			143.509	3	.000			
	High school	-.126	.093	1.828	1	.176	.882	.735	1.058
	College	.575	.103	30.906	1	.000	1.777	1.451	2.176
	Advanced degree	1.051	.124	71.567	1	.000	2.861	2.243	3.651
	Sex (Male)	.006	.069	.009	1	.926	1.006	.880	1.151
	Age: 18 to 25			357.078	5	.000			
	Age: 26 to 33	1.493	.149	101.032	1	.000	4.452	3.327	5.957
	Age: 34 to 41	1.615	.143	128.025	1	.000	5.029	3.802	6.653
	Age: 42 to 49	1.929	.161	144.331	1	.000	6.884	5.025	9.431
	Age: 50 to 57	1.063	.110	92.679	1	.000	2.896	2.332	3.596
	Age: ≥58	1.023	.114	80.643	1	.000	2.783	2.226	3.479
	Constant	3.165	.079	1600.068	1	.000	23.693		

a. Variable(s) entered on step 1: EducationLevel, SexV, AGE.

Only Sex Variable Included in the Model

In the following regression model shown in Table 13, only the sex variable was included in the analysis. The Cox & Snell R Square and Nagelkerke R Square values shown in Table 13 ranged from ranged from 0.5% to 4.3% respectively. It means that about 0.5% to 4.3% of vision impairment could be explained by educational attainment in the presence of sex alone.

Table 11

Variance explained for educational attainment variable – Sex Included in the model

Step	-2 Log likelihood	Cox & Snell R square	Nagelkerke R square
1	9269.555[a]	.005	.043

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Category prediction. The binary logistic regression assessment of the observed and predicted values were shown in Table 14 below. As per the results provided, 902 individuals had vision difficulty when only sex was included in the analysis. About, 69,672 individuals did not have vision difficulty when only sex was included in the analysis of the effect of educational attainment on vision impairments.

Table 12

Category prediction for educational attainment variable – sex included in the model

	Observed		Predicted vision difficulty Yes	No	Percentage correct
Step 1	Vision difficulty	Yes	0	902	.0
		No	0	69672	100.0
	Overall Percentage				98.7

a. The cut value is .500

Variables in the equation. Shown in Table 15, for the analysis of sex and educational level on vision impairment among the Asians population selected in this study. *Wald* was used to determine the effects of educational attainment on vision impairment among the Asian population when only sex was added to the model. In this model shown in Table 15, the sex estimate was, $\beta = .021$, $W(1) = 0.095$, $OR = 1.021$, $p = .758$, *95% CI [.894, 1.167]*. Sex did not predict vision impairment, $p = 0.758$. The odds ratio of 1.021 suggested that male were 1.02 times likely to have vision impairment as females. In other words, both male and female had the similar risk.

For education levels, high school category showed $\beta = .354$, $W(1) = 15.461$, $OR = 1.425$, $p^{***} < 0.001$, *95% CI [1.194, 1.700]*. This also means that individuals with ‘high school’ category in educational attainment variable presented with $p^{***} < 0.001$ suggested significance for vision impairment. Odds ratio results represented odds of vision impairment for ‘high school’ group is 1 times higher than no school. For college degree, $\beta = 1.311$, $W(1) = 178.661$, $OR = 3.709$, $p^{***} < 0.001$, *95% CI [3.061, 4.496]*. The college degree group predicted vision impairment. The odds ratio suggested that people with college degree are 4 times more likely to have vision impairment then individuals in the no school group.

For ‘advanced degrees’, *β = 1.827, W(1) = 237.723, OR = 6.218, p*** < 0.001, 95% CI [4.928, 7.845]*. As per these results, ‘individuals in the advanced degrees’ group predicted vision impairment. The odds for having vision impairment among individuals in the ‘advanced degree’ group was 6 times higher than the ‘no school’ group. We selected the ‘no school’ degree group as the reference in this analysis. Therefore, based on the risk estimates shown in table 15, the null hypothesis was rejected. In other words, there was an association between educational attainment and vision impairment. Individuals with advanced degree were at higher risk of vision impairment.

Table 13

Sex variable in the equation for educational attainment

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	No school			364.487	3	.000			
	High school	.354	.090	15.461	1	.000	1.425	1.194	1.700
	College	1.311	.098	178.661	1	.000	3.709	3.061	4.496
	Advanced degrees	1.827	.119	237.273	1	.000	6.218	4.928	7.845
	Sex (Male)	.021	.068	.095	1	.758	1.021	.894	1.167
	Constant	3.408	.078	1905.521	1	.000	30.220		

a. Variable(s) entered on step 1: EducationLevel, SexV.

Prevalence of Educations Levels

The vision impairment prevalence based on education attainments was estimated using the formula below:

*Prevalence = (Number of cases/Total population size) *1000*

The vision impairment prevalence estimation based on educational attainment categories were as follows:

Prevalence of vision impairments among 'No School' participants = 196/6172 = 0.0317 * 1000 = 31.8

Prevalence of vision impairments among 'High School' participants = 359/15956 = 0.0224 * 1000 = 22.5

Prevalence of vision impairments among 'College' participants = 232/26477 = 0.00876 * 1000 = 8.8

Prevalence of vision impairments among 'Advanced Degree' participants = 115/21969 = 0.00523 * 1000 = 5.2

The total prevalence of vision impairment for the participants selected was estimated as follows:

Total Prevalence = 902/70574 = 0.0127 * 1000 = 12.8

Total prevalence of vision impairment among the Asian participants for all the educational levels combined was 13 individuals per 1000 persons.

Logistic Regression Model: Assessment of relationship between Geographical Locations and Vision Impairment

Logistic regression analyses provided below were used to address the following research question and hypothesis.

RQ2: Were there differences in the prevalence of vision impairment among Asian-Americans based on the geographical locations of residence (east, west, north, and south).

H_{02}: There were no differences between geographical locations (east, west, north, and south) and vision impairment prevalence

H_{a2}: There were difference between geographical locations (east, west, north, and south) and vision impairment prevalence.

Assessment of Primary and Outcome Variable

Shown in Table 16 was the model summary of the residential geographical locations and its effect on vision impairments without the inclusion of any covariates. The explained variation in the vision impairment variable based on the model ranged from 0% to 0.1%. In other words, about 0% to 0.1% of vision impairment could be explained by the residential geographical locations.

Table 14

Variance explained for geographical locations variable

Step	-2 Log likelihood	Cox & Snell R square	Nagelkerke R square
1	17589.031[a]	.000	.001

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Category Prediction for Geographical Locations

Shown in Table 17 was the category prediction table for residential geographical locations, and its effect on vision impairments. As shown in Table 17, about 1654 participants had vision difficulty and 123,687 Asians in the study did not have vision difficulty.

Table 15

Category prediction for geographical locations variables

	Observed		Predicted vision difficulty Yes	No	*Percentage correct*
Step 1	Vision difficulty	Yes	0	1654	.0
		No	0	123687	100.0
	Overall Percentage				98.7

a. The cut value is .500

Variables in the Equation for Geographical Locations

Shown in Table 18 was the effect of geographical locations on vision impairment. In this model, the east region was selected as a reference group for all the other locations. Geolocation predicted vision impairment among the Asian population, $W(3) = 13.189$, $p = 0.004$. There the null hypothesis should be rejected. The west region estimate was $\beta = -.201$, $W(1) = 12.748$, $OR = .818$, $p^{***} < 0.001$, *95% CI [.733, .914]*. Based on this estimate, the vision impairment for individuals living in the west region compared to east was statistically significant. For individuals living in the north region the vision impairment risk estimate was, $\beta = -.151$, $W(1) = 1.303$, $OR = .860$, $p = .254$, *95% CI [.663, 1.115]*. As a result, individuals living in the north region did not predict vision impairment. Similarly, the vision impairment risk estimate for individuals living in the south region was $\beta = -.238$, $W(1) = 2.464$, $OR = .788$, $p = .116$, *95% CI [.586, 1.061]*.

Based on this estimate, individuals living in the south region did not predict vision impairment.

Table 16

Variable in the equation for geographical locations variable

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	East			13.189	3	.004			
	West	-.201	.056	12.748	1	.000	.818	.733	.914
	North	-.151	.133	1.303	1	.254	.860	.663	1.115
	South	-.238	.151	2.464	1	.116	.788	.586	1.061
	Constant	4.455	.047	8945.486	1	.000	86.039		

a. Variable(s) entered on step 1: Geolocation.

Age and Sex Variables Included in the Model

Shown in Table 19 was the model summary of the residential geographical locations and its effect on vision impairments. The explained variation in the vision impairment variable based on the model ranged from 4% to 30%. In other words, about 4% to 30% of vision impairment could be explained by the residential geographical locations.

Table 17

Variance explained for geographical locations variable – age and sex included in the model

Step	-2 Log likelihood	Cox & Snell R square	Nagelkerke R square
1	17108.983[a]	.004	.030

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Category Prediction for Geographical Locations, Age, and Sex

Shown in Table 20 was the category prediction table for residential geographical locations, age, and sex on vision impairments. As shown in the table, 1654 individuals predicted vision difficulty when age and sex were included in the model. Also, 123687 individuals predicted not having any vision difficulty when age and sex were included in the assessments of vision impairment by geographical locations.

Table 18

Category prediction for geographical locations, age, and sex variables

	Observed		Predicted vision difficulty Yes	Predicted vision difficulty No	Percentage correct
Step 1	Vision difficulty	Yes	0	1654	.0
		No	0	123687	100.0
	Overall Percentage				98.7

a. The cut value is .500

Variables in the Equation for the Geographical Locations, Age, and Sex

Shown in Table 21, was the effects of age, sex, and geographical locations on vision impairment. In this model, for sex, $\beta = .189$, $W(1) = 14.232$, $OR = 1.209$, $p^{***} < 0.001$, *95% CI [1.095, 1.334]*. Sex significantly predicted vision impairment based on geographical locations. Similarly, age significantly predicted vision impairment based on geographical locations, $W(5) = 396.448$, $p^{***}<0.001$. Also, all the age categories also predicted vision impairment based on geographical locations, see Table 21. The odds ratio for age group 42 to 49 was highest and it is about *4.702* more likely for individual in that age group to have vision impairment for than age group 18 to 25. Therefore, age was a significant predictor for vision impairment.

The effect of geographical locations on vision impairment after controlling for sex and age was statistically significant, $W(3) = 11.711$, $p=0.008$. Thus, the Null Hypothesis was rejected. For the geographical locations, the east region was the reference group. The comparison between the east and the west produced an estimation for individuals living in the west as follows; $\beta = .235$, $W(1) = 2.389$, $OR = 1.264$, $p = .122$, *95% CI [.939, 1.702]*. Based on this estimate, vision impairment among individuals living in the west region was not statistically significant. Also, the vision impairment estimate for individuals living in the north region was as follows; $\beta = .046$, $W(1) = .097$, $OR = 1.047$, $p = .755$, *95% CI [.784, 1.398]*, and were not statistically significant. Similarly, vision impairment estimated among individuals living in the south region was as follows; $\beta = .090$, $W(1) = .225$, $OR = 1.094$, $p = .635$, *95% CI [.754, 1.589]*, which were not statistically significant. As per these results, the west, north, and south region did not predict vision impairment, see Table 21.

Table 19

Age and sex variables in the equation for geographical locations variable

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Sex (Male)	.189	.050	14.232	1	.000	1.209	1.095	1.334
	Age 18 to 25			396.448	5	.000			
	Age 26 to 33	1.057	.100	110.923	1	.000	2.878	2.364	3.504
	Age 34 to 41	1.274	.107	141.609	1	.000	3.576	2.899	4.412
	Age 42 to 49	1.548	.119	168.658	1	.000	4.702	3.722	5.939
	Age 50 to 57	.762	.086	78.184	1	.000	2.142	1.809	2.536
	Age ≥58	.430	.082	27.805	1	.000	1.537	1.310	1.804
	East			11.711	3	.008			
	West	.235	.152	2.389	1	.122	1.264	.939	1.702
	North	.046	.147	.097	1	.755	1.047	.784	1.398
	South	.090	.190	.225	1	.635	1.094	.754	1.589
	Constant	3.650	.147	617.570	1	.000	38.482		

a. Variable(s) entered on step 1: SexV, Age, Geolocation.

Only Sex variable included in the model. Shown in Table 22 was the model summary of the residential geographical locations and its effect on vision impairments in the presence of sex alone. The explained variation in the vision impairment variable based on the model ranged from 0% to 0.2%. In other words, about 0% to 0.2% of vision impairment could be explained by the residential geographical locations in the presence the sex category.

Variance Explained

Table 20

Variance explained for geographical locations variable – sex included in the model

Step	-2 Log likelihood	Cox & Snell R square	Nagelkerke R square
1	17575.028[a]	.000	.002

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Category Prediction

Shown in Table 23 was the category prediction table for residential geographical locations, and sex its effect on vision impairments. As shown in the table, 1654 individuals predicated having vision impairment when only sex was included in the assessment of vision impairment by geographical locations. Also, 123687 individuals did not have any vision difficulty when only sex was included in the model for vision impairment by geographical locations.

Table 21

Category prediction for geographical locations and sex Variables

	Observed		Predicted vision difficulty		Percentage correct
			Yes	No	
Step 1	Vision difficulty	Yes	0	1654	.0
		No	0	123687	100.0
	Overall Percentage				98.7

a. The cut value is .500

Variables in the equation. shown in Table 24 included the effects of sex and geographical locations on vision impairment. In this model, sex (Male) predicted vision impairment, *β= -.187, W(1) = 13.890, OR = .830, p*** < 0.001, 95% CI [.752, .915]*. As shown in Table 24 below, there were relationships between sex and vision impairment, and for a unit change in sex, there was a -0.187 change in vision impairment. However, the OR was less than 1 (0.830). It meant that males were 0.17 (17%) less likely than female to have vision impairment than females.

The geographical location estimate was statistically significant *W(3) =13.277, p = 0.004*. As such, geographical location predicted vision impairment among the Asian population under investigation. Based on this, the null hypothesis was rejected. For the interaction assessment of the geographical location categories, the east region was used as the reference group. The risk estimate for individuals living in the west region was shown as follows; *β = .234, W(1) = 2.385, OR = 1.263, p = .123, 95% CI [.939, 1.700]*. Based on the estimate, vision impairment among individuals living in the west region was not statistically significant compared to those living in the east. Therefore, west region did not predict vision impairment. The north region risk estimate was *β = .032, W(1) = .048, OR = 1.033, p = .826, 95% CI [.774, 1.378]*. Similarly, the south region estimate was shown as follows; *β = .085, W(1) = .201, OR = 1.089, p = .750, 95% CI [.750, 1.580]*. Based on this estimated both the north and south regions did not predict vision impairments**.**

Table 22

Sex variable in the equation for geographical locations variable

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Sex (Male)	-.187	.050	13.890	1	.000	.830	.752	.915
	East			13.277	3	.004			
	West	.234	.151	2.385	1	.123	1.263	.939	1.700
	North	.032	.147	.048	1	.826	1.033	.774	1.378
	South	.085	.190	.201	1	.654	1.089	.750	1.580
	Constant	4.325	.147	865.392	1	.000	75.572		

a. Variable(s) entered on step 1: SexV, Geolocation.

Prevalence of Vision Impairment Based on Geographical Locations

The vision impairment prevalence estimation based on the geographical location categories were as follows:

Prevalence of vision impairments among participants living in ‘East’ region =49/39690 = 0.00123 * 1000 = 1.23

Prevalence of vision impairments among participants living in ‘West’ region = 1083/77331 = 0.0140 * 1000 = 14

Prevalence of vision impairments among participants living in ‘North’ region = 66/4947 = 0.0133 * 1000 = 13.3

Prevalence of vision impairments among participants living in ‘South’ region = 456/3373 = 0.1351 * 1000 = 135.2

The total prevalence of vision impairment for the participants selected by geographical locations was estimated as follows:

Total Prevalence = 1654/70574 = 0.02343 * 1000 = 23.4

Total prevalence of vision impairment among the Asian participants for all the geographical locations combined was 23 individuals per 1000 persons.

Summary

A logistic regression was performed to estimate the relationship between age, sex, educational attainment, and geographical locations on the likelihood of participants to have vision impairment. Educational attainments or geographical locations alone in the model produced $p^{***} < 0.001$ or $p = 0.004$ as shown in Table 9 and 18 respectively. Based on the findings education attainment and geographical location were significant predictors of vision impairment. When sex and age were added together in the model in addition to educational attainment, age was statistically significant as well as education $p^{***} < 0.001$. In contrast, sex was not significant in the model, $p = 0.926$. When sex was assessed by itself in the model of assessment of relationship between educational attainment and vision impairment, sex was not a significant predictor of the relationship between educational attainment and vision impairment, $p = .758$. Therefore, only age was fit to be included in the regression model in the presence of education levels and not sex.

When sex and age were added together in the model to assess the relationship between geographical locations and vision impairment, both age and sex were statistically significant, $p^{***} < 0.001$. When sex was assessed by itself in the same model for assessing the geographical location effects on vision impairment, sex significantly predicted the relationship between geographical locations and vision impairment, *p*** < 0.001*.

The adjusted OR associated for age group ≥58 years old for the educational attainment analysis on vision impairment was 2.783 [95% CI 2.226 to 3.479]. Almost all categories of age showed similar results which still suggested that the risk of vision impairments in different age groups were higher than the referenced group (18-25 years old group). The adjusted OR associated with age group ≥58 for the geographical locations effect on vision impairment was 1.537 [95% CI .1.310 to 1.804]. The adjusted OR associated with sex in geographical locations for vision impairment was 1.209 [95% CI 1.095 to 1.334]. The adjusted OR associated with 'High School' was 1.4 [95% CI 1.194 to 1.700], 'College' was 3.1 [95% CI 3.061 to 4.497], and 'Advanced Degree' was 6.2 [95% CI 4.942 to 7.860] without adjusting for age and sex. The higher the degree the higher the odds ratio among educational attainment category was found for vision impairment. The adjusted OR associated with sex for the educational attainment on vision impairment was 1.006 [95% CI .880 to 1.151].

The first research question was addressed by stating that there were associations between vision impairment prevalence and level of education because of results of *p*** < 0.001*. Therefore, the null hypothesis was rejected and the alternative accepted. A second research question posed for the assessment of the difference in the prevalence of vision impairment among Asian-Americans based on the geographical locations of residence based showed a *p*** < 0.001*. Similarly, the null hypothesis indicated that there were no differences between geographical locations and vision impairment prevalence was rejected. The alternative hypothesis was accepted, which supported the idea that there were differences between geographical locations (north, south, east, and west) of participants and their vision impairment.

The model explained 30.0% (Nagelkerke R^2) of the variance in vision impairment and correctly classified 98.7% of cases. Differences in age and sex variables showed effects in the model which supported the idea that there were relationships between level of education, geographical locations, and vision impairment. Age was a significant confounder in the model for educational attainment, geographical location and vision impairment. Sex was not found to be a significant confounder. Educational attainment had an association with likelihood of exhibiting vision impairment. Variations in geographical locations also had likelihood with exhibiting possibilities of vision impairment.

Despite of not having any visible flaws in the study design with respect to binary logistic regression analysis, logistic regression seemed to be a successful attempt. The results exhibited 98.7% accuracy which was very significant. Also, likelihood of vision impairment due to OR for educational attainment and geographical locations exhibited in the results supported the success of the model. Further discussion and recommendations of this study were provided in chapter 5 below.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

There were no causal inferences made in this study, rather I made correlational inferences between education level, geographical location, and vision impairment. There were challenges due to ongoing immigration of people in United States, geographical distribution of vision impairment cases was difficult to predict; however, the results in this study exhibited some significant differences between geographical location and vision impairment. The purpose of this study was to explore the relationship between education level, geographical location, and vision impairment. The results advanced an in-depth understanding about these relationships. The findings of this study provided a possible link between geographical location and vision impairment. There were also possible links identified between educational attainment and vision impairment. I have used secondary data and logistic regression in this study to address research questions. Inclusion of age and sex in the model provided variations in the analysis, and these variables had some effects on the relationship between educational attainment or geographical location and vision impairment.

Interpretation of the Findings

The findings from this study confirmed what has been presented in the peer-reviewed literature. For example, as indicated in Chapter 2, Varma et al. (2016) provided statistical distribution of vision impairment by geographical location when they stated that the state of Florida had high significance of vision impairment with 3.98% of their participants. In this study, geographical location predicted vision impairment overall, but residing in the west, south, and north of the United States is not predictive of vision impairment (see Tables 21 and 24).

I used the social ecological theory to describe this study and provide assessments of various personal and environmental factors. The application of social ecological theory allowed for an in-depth understanding of the relationships between educational attainment, geographical locations, and vision impairment. For example, the results of this study suggested a possible link between sex and vision impairment or age and vision impairment when evaluated separately or together without adjusting for other variables in the model. As emphasized in Chapter 2, some people could adjust better in coping with vision impairment than others. However, the social ecological theory helped in explaining the inherent relationships between geographical distribution and vision impairment based on the set criteria applied in this study. There were variations of vision impairment found among Asians across the North, South, East, and West of the United States. Individuals who lived in the West were significantly impacted by vision impairments as compared to those living in the East. However, data from the North and South did not show any significance as compared to the East. In summary, these variations suggest that vision impairment can be described by the geographical location of individuals.

Wilson et al. (2014) evaluated vision impairment between U.S. citizens and noncitizens. In their study, the estimated odds ratio for vision impairment among noncitizens was 3.5 (95% CI 1.52-7.83); in other words, noncitizens are about 3.5 times more likely than citizens to have vision impairment (Wilson et al., 2014). The odds ratio estimation from the Ramke et al. (2015) study showed similar risk. In the study, Ramke et al. showed that the blindness prevalence of vision impairment was 15 times higher from 1990 to 2010 in West African region. The vision impairment study among U.S. adults conducted by Chou et al. (2013) also showed that the odds of health outcomes were similar (1.09) for the groups being compared by age but were shown to be 2.99 times higher among individuals with less than high school education. The risk estimates conducted in this study are similar in many ways to the studies described above.

Limitations of the Study

As described in Chapter 1, the main limitation in this study was the data integrity. The secondary dataset used in this study could have impacted the results of the study. Despite the precautions taken regarding the quality of the assessments, there is a slight chance that the results were not supporting what was proposed in the beginning of the study. The results regarding relationship between educational attainment and vision impairment were supported, and that was already anticipated. The dataset was huge, and it is impossible to assess every data point, but in this study, I assessed primary independent variables, which are educational attainment and geographical locations. The confounding variables age and sex were included in the analysis to strengthen the validity. I found possible relationships between age, sex, level of education, and vision impairment among Asian participants when assessed each variable individually. They may also have their individual effects; for example, age of the participants with relation to educational attainment could vary because a 65-year-old individual could possess advanced education accomplishment as compared to most individuals in the 18- to 25-

year-old group or other younger age groups specified in this study. The results suggested that age of the participants had a more positive influence on the outcome, $p^{***} < 0.001$, when age was assessed along with sex. While sex did not show significance in the model, it can also be considered as a confounder. It is not possible to assess every confounding variable in the study, but confounders that were not assessed could have shown some link with the current results. However, the major confounding variables, age and sex, were included in the model which provided validity and reliability in the study.

Recommendations

The strength of the study was the use of a large dataset. Statistical analysis on the large dataset strengthened the validity of the study. Use of a large dataset showed less errors in the analysis. As shown above, the dataset included 3,916,947 participants, 33% of whom were Asians. Logistic regression was performed on 129,252 Asian participants, which provided strong support in the analysis. The larger the dataset, the stronger the validity in the study (Cresswell, 2009). The limitations of the study as described above could also be the integrity of the dataset. The dataset was provided by United States Census Bureau, and even though it included all variables required for the assessment in this study, the responses from participants are solely based on their voluntary responses. We can only hope that participants provided answers with complete responses and accurate information. The United States Census Bureau is governmental organization, and they conduct surveys periodically so the database is a live link. These data in this database are fluid and change periodically as well. Thus, the results in this study are based on what was provided in the dataset at the time. Major recommendations could be to assess the datasets from other time periods and compare them with what has been discovered in this study. There were possible links discovered in the results of this study between educational attainment, geographical location of the participants, and vision impairment cases. Other confounding variables could be explored further in future studies along with their relationships with various factors because sex impacted both educational attainment and geographical locations of participants with vision impairment when it was assessed alone without any other confounders.

Implications

The results of this study supported positive social change for Asian American participants. The social change could be implicated at an individual level where Asian Americans living in different areas of the United States—North, South, East, or West—could potentially have an impact on their eye health. In other words, as found in my study, vision impairment cases were high in Asians who were living in West region, such information could be useful to the policy makers to design policies to help communities residing in West region of United States. Varma et al. (2016) found that vision impairment for all racial groups was high in South states of the United States. Similarly, the social change could also be impacted by Asian Americans by their educational accomplishments. In my study, I found that the higher the degree, the higher the risk for vision impairment among Asian Americans. This information again can be useful for public health professionals when they are designing interventions so that they could specifically focus on links between educational attainments and vision impairment.

In this study, there were links found between age and sex of the participants. It can be inferred that Asian men may have higher risk of vision impairment than Asian women. Similarly, the age of the participants could dictate their risk of vision impairment. Such information could be helpful in the advancement of policy making and driving awareness. Social ecological theory, which was used in this study, helped Harvey et al. (2016) provide understanding of health and well-being of participants. The results from this study also expanded the understanding of vision impairment among Asians and how factors such as educational attainment, geographical locations, age, and sex of the participants could potentially impact their vision impairment incidence and prevalence.

As stated in the above paragraph, the recommendations in this study should encourage further exploration on this topic. The data used in this study spanned from 2011 to 2015, but these data could also be compared with the 2016 and 2017 datasets to find possible variations in the outcome if any. In summary, this study had some successes and some limitations, but the study provided information to be explored further in driving positive social change in the Asian communities living in United States with vision impairments.

Conclusion

Vision impairment is a growing concern in various communities around the world, and due to the high risk described by researchers in Asian communities, I attempted in this study to explore the relationship of various factors with vision impairments in Asian Americans. The large secondary dataset I analyzed was provided by the United States Census Bureau. Results from this study indicated a relationship between geographical locations and vision impairment. I also found a positive relationship between educational attainment, geographical location, age, and sex of the participants and vision impairment. There were links between educational attainment of participants and vision impairment and between geographical location of participants and vision impairment. Further studies have been suggested to explore these relationships. The results of the study suggested potential for positive social change in Asian communities. Information such as the relationship between educational attainment, geographical location, age, and sex of the participants could impact the vision impairment diagnosis among this population, and such information could help public health professionals with the advancement of public awareness. The results from this study could help public health professionals such as myself to understand vision impairment in greater detail.

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