The Quality of Life Of Patients with Eye Diseases

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Epidemiology and Biostatistics
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Abstract

**Background:** Health-related Quality of Life (HRQoL) values determined using direct elicitation methods and generic preference-based measures are important for economic evaluations of healthcare interventions. The ophthalmology clientele is vulnerable to psychological stressors in the context of the coronavirus disease 2019 (COVID-19) pandemic.

**Objectives:** To systematically identify and summarize the quality of life (QoL) of eye disease patients in general in North America and seniors with eye diseases during the COVID-19 pandemic.

**Methods:** A systematic review identified North American studies that quantified HRQoL of eye disease patients. A cross-sectional study was conducted among seniors with eye diseases and backwards stepwise regression models were built.

**Results:** The systematic review revealed that HRQoL across patients with glaucoma, age-related macular degeneration (ARMD), diabetic retinopathy (DR), cataracts, uveitis, and dry eye disease (DED) was similar using the SF-12 and SF-36. Utility values across patients with ARMD, DR, cataracts, uveitis, and DED appear to be similar while values in patients with glaucoma appear to be higher. The cross-sectional survey revealed that HRQoL, vision-related QoL (VRQoL), and sleep quality appeared to be good. Depression and anxiety symptoms appeared to be low, while community integration and social support were moderate. The presence of retinal disease and the number of non-ocular comorbidities negatively impacted VRQoL and social support and community integration. Education
impacted social support and community integration negatively. Of mobility aids appeared to negatively affect depressive symptoms and sleep quality.

**Conclusion:** Overall QoL among North American patients and seniors with eye diseases appeared to be generally good.

**Keywords**

Eye disease, quality of life, seniors, ophthalmology, COVID-19, coronavirus 2019, pandemic
Summary for Lay Audience

Eye diseases have been associated with numerous negative impacts on a patient’s quality of life (QoL) and overall wellbeing. This thesis investigates the QoL of patients with eye diseases from two different angles. The first angle is through a systematic review of literature that looks at QoL from a health economics point of view. In particular, the review focuses on the values produced by standardized questionnaires and techniques from previous studies to quantify the overall QoL of North American patients with eye diseases. This review revealed that the QoL across patients with glaucoma, age-related macular degeneration, diabetic retinopathy, cataracts, uveitis, and dry eye disease appeared to be similar. However, there may be evidence that the QoL of patients with glaucoma is higher than in patients with other diseases.

The second angle in which QoL of eye disease patients is investigated is through conducting a survey that specifically focuses on seniors with eye diseases to see how their QoL has been during the recent coronavirus disease 2019 (COVID-19) pandemic. This survey looked at QoL using many different measures. The results of this survey revealed that the QoL and sleep quality of seniors with eye diseases appeared to be good. Depression and anxiety appeared to be low, while community integration and social support were moderate. More specifically, having retinal disease and more non-eye diseases negatively affected visual aspects of QoL and community integration and social support. Having a greater education also appeared to negatively affect community integration and social support. Finally, the use of a mobility aid appeared to negatively affect sleep quality and depression. The findings revealed by these studies are important because they could provide necessary information for
making economic assessments and evaluations for many different eye diseases. Furthermore, the findings help potentially quantify the effects of COVID-19 beyond the direct impact of the virus. This, in turn, may help to improve the future quality of care during non-COVID-19 conditions and during potential future pandemic situations. Overall, the findings from this thesis may be used to improve patients' overall care for eye diseases in the future.
Co-Authorship Statement

All chapters of this thesis were written by me, Brian Yu, to partially fulfill the requirements of the degree of Master of Science in Epidemiology. I was involved in all aspects of the studies startup and completion, including the development of the data collection tool and research objectives, patient recruitment, data collection, data entry, data analysis, and creating summary reports. My fellow co-authors Hyunsoo Jang, Samantha So, Michael Huang, and Teng Qing Wang aided me in patient recruitment and data collection as well. My thesis supervisors Dr. Monali Malvankar and Dr. Shehzad Ali, provided guidance and valuable feedback throughout the entire process.
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Chapter 1

1 Introduction

Eye diseases have been associated with numerous negative impacts on a patient’s quality of life (QoL). Assessing the QoL of a patient with eye disease is important in identifying the severity of visual impairment to the patient's well-being. QoL is the individual perception of a patient about their position in life including the psychological, social, and physical domains. Therefore, health-related QoL (HRQoL) focuses on their beliefs, expectations, and experiences with their disease and treatment in the context of one’s health. This chapter introduces an evaluation of the QoL of patients with eye disease and visual impairment to identify the major threats of the eye diseases to their lives. Vision-related QoL (VRQoL) reflects a patient's perception of their visual abilities and the associated impacts on their general life experience. Hence, the assessment of their QoL will reveal the progression of eye disease and its impacts on their visual capabilities as well as the quality of their life. In general, this research project evaluates different states of visual impairment that have significant impacts on a person’s QoL.

Vision forms an integral part of a person’s life. From a functional point of view, vision and eyesight account for a large percentage of a person’s performance in their social and functional life \(^1\). Thus, vision provides them with access to almost all areas of life including their social, physical, and emotional experiences. Based on this concept, visual health forms an integral part of a person’s life and can cause various impacts if vision impairment occurs. Therefore, VRQoL also reflects the role of visual perceptions
on a person’s participation in daily life activities including mobility, religion, and recreation among others \(^2,^3\).

Changes in the visual capabilities of a person may affect their QoL in many ways. At first glance, eye diseases cause negative changes in a patient's mental, emotional, and physical health \(^4,^5\). A patient may lose their ability to perform visual functions, such as contrast sensitivity, color perception, and adaptation to light, due to eye disease. The progression of eye disease also affects the extent of their visual perceptions and adaptation to general life negatively. For instance, patients tend to lose self-reliance, self-sufficiency, and social status when they suffer visual impairment. Such changes in their visual capabilities cause damage to their life experiences by reducing their mobility, strengths, and experiential learning \(^6\). The result is a lack of satisfaction with their visual capabilities and a subsequent loss of their general functionality. In the end, they face restrictions in all areas of their life leading to a lower quality of their daily life experience.

The assessment of VRQoL also reveals the prevalence of different eye diseases and their influence on patients’ daily lives. Vision impairment includes various eye-related defects or diseases, such as eye swelling, thyroid eye disease, glaucoma, diplopia, and blindness \(^7\). These eye conditions and many others are a global concern because of their significant impacts on the physical and mental capabilities of patients. Eye disease is a common burden among adult patients above the age of 65 years whose medical history incorporates ophthalmological conditions \(^8\). The age-specific prevalence of eye disease is likely to increase due to aging and multiple incapacitating conditions, such as depression, anxiety, and frustration. The result is a progression in eye damage and increased chronic conditions that require medical or surgical treatment. Such conditions reflect the impacts
of eye disease on general health that lead to the reduction of patient’s performance and general life experience.

Through measuring the QoL among eye disease patients, the current thesis seeks to portray the relevance of research in the health-related issue. It provides an objective clinical measure of eye disease among patients with ophthalmologic conditions. It also identifies the relationship between eye disease and the multiple conditions associated with the patient’s QoL. Vision impairment is associated with negative health, social, and functional outcomes that reduce the patients’ QoL. Patient-reported outcomes are important instruments for identifying the relationship between eye disease and the QoL among patients with chronic conditions. Therefore, the current research project will provide important measures for gathering data and information about the large impact of eye disease on a patient’s QoL.

Overall, a general view of the global research on the QoL reveals the impacts of eye health on the quality of a patient’s life. This chapter uses the definitions of eye disease and QoL to enhance the understanding of the relationship between visual impairment and a patient's QoL. Research findings from this thesis will depict the relationship between various types of eye diseases and the QoL scores of patients with various ophthalmological conditions.
1.1 References


Chapter 2 Literature Review

2 Introduction

This thesis explores the quality of life (QoL) in patients with eye diseases in general and specifically seniors with eye diseases during the coronavirus disease 2019 (COVID-19) pandemic. Therefore, understanding the many aspects of QoL, including feelings of depression and anxiety, sleep quality, and social support to vision-related quality of life (VRQoL) and health-related quality of life (HRQoL) is critical.

2.1 Background of Quality of Life

Exploration of the domains of QoL can help ascertain the impact of illness on a patient's life. QoL plays an integral role in understanding a patient's perception of their health, well-being, and life satisfaction. It is stated that the World Health Organization (WHO) defines QoL as "an individual's perception of one’s position in life in the context of the culture and value systems in which one lives and about one’s goals, expectations, standards and concerns." The WHO goes further to use the dimensions of physical health, social relationships, psychological health, and the immediate environment of individuals in the society to establish the QoL across the varied social groups and diverse cultures.

The environmental aspect measures the quality of air, presence of pollution, ambient noise, and damage to property since it determines the health of an individual. Low QoL is indicated by the presence of pollution in both air and environment, resulting in the spread of certain diseases and infections. The social and cultural aspects explore the
beliefs, practices, and belief systems of individuals in society and how they affect access to healthcare. Notably, there are some societies where accessing mental health services is perceived as a sign of weakness, which affects the QoL of individuals in society. Additionally, health-promoting behaviors and the physical health of an individual play an integral role in supporting people's health. For instance, hiking trails, playgrounds, and the safety of the social infrastructure in society enhance mental health, reduce stress, and promote healthy living. Furthermore, physical health, translated as having no infections or the lack of illness, enhances the QoL.

Mental health is a critical element of the QoL. The WHO defines it as a state in which individuals can realize their capabilities, work fruitfully and productively, cope with stress in life, and contribute positively to society. The mental health of an individual is measured by the capacity to overcome depression, anxiety, and low sleep quality while experiencing enhanced community integration and social support. In essence, individuals who experience mental health disorders such as anxiety, depression, and distress have a low QoL. To promote patients' well-being and health, it is critical to comprehend the many factors that impact the QoL of an individual.

2.2 Health-related Quality of Life

HRQoL relates to the multi-dimensional concepts that explore the domains associated with the mental, physical, social functioning and emotional health of an individual. The measures transcend the direct standards that explore life expectancy, population health, and causes of health, focusing on enhancing the health status of individuals in society. The measurement of HRQoL seeks to establish the burden of preventable injuries, diseases, and disabilities while offering valuable new insights on the
correlation between risk factors and HRQoL. In essence, measuring HRQoL provides an opportunity to monitor the process of a nation in the realization of health objectives. The approach is critical in enhancing the QoL of individuals since it explores the life burden, socio-economic status, cultural, social support, and demographical factors. In essence, the element explores the impacts of culture, nationality, life attitudes, spirituality, gender, and age concerning the quality and access to medical care. HRQoL and QoL are interrelated as they seek to ensure that an individual's quality care and well-being are enhanced. However, HRQoL focuses more on disease burden, while the QoL explores elements such as environmental effects on individuals' health and well-being. HRQoL can measure various elements that include life expectancy, survival, psychological state, pain, physical function, ambulation and mobility, and sexual function. It can also measure elements like disability, impairments, handicaps, and cognitive functions such as depression and anxiety, just like QoL.

2.3 Vision-Related quality of life

VRQoL measures the degree to which vision impacts an individual’s economic well-being, emotional and social status, and ability to perform daily activities. The measure of VRQoL entails exploring the impairment degree that affects the ability of an individual to perform activities that rely on their sight. Moreover, VRQoL measures the ability of an individual to feel satisfied with their visual capabilities. Like the other types of QoL discussed above, VRQoL also explores how one’s visual capability affects one’s psychological state, physical health, social relationships, and level of independence. Arguably, vision affects the ability of an individual to perform daily chores, improve their social life, and take part in functional activities. As a result, visual impairments restrict
the life of individuals, including participating in religious activities, daily routines, recreation, mobility, and intense visual tasks. Like HRQoL, poor VRQoL impacts an individual's mental well-being and health as it causes frustration, depression, and anxiety. Thus, it is of great value to assess the social participation, emotional state, mobility, and daily activity of a person about their VRQOL.

2.4 How to measure the different Qualities of Life

2.4.1 Measuring specific correlates of Quality of Life

The increased prevalence of depressive signs concerns social workers as it correlates with adverse health outcomes and QoL, cognitive disability, medical illnesses, suicide, and increased economic burden on patients and their families. Researchers and healthcare workers alike are faced with the challenges of measuring depressive symptoms owing to a lack of standardized measures; thus, they seek valid and brief indicators. Among the available indicators is the Center for Epidemiologic Studies Depression Scale (CES-D), which is a 20-item adapted for large-scale surveys critical in measuring the depressive symptomology in older patients. The CES-D presents a valuable tool in the assessment of subthreshold depression. According to Jiang et al., CES-D entails high reliability and validity in subthreshold depression, which is adequate to measure depressive disorders. The CES-D was primarily designed for use in epidemiologic studies, specifically in assessing the prevalence of depressive symptoms and determining the at-risk population for depression among the general population. The recommended criteria for determining the existence of subthreshold depression among individuals is a
score of 16 out of the self-rating 20-item scale. Thus, the CES-D provides an adequate tool for assessing depressive symptoms among individuals.

The Hospital Anxiety and Depression Scale (HADS) is considered an influential instrument that measures states of depression and anxiety in hospital outpatient clinics. The tool is a reliable instrument as it has seven items that measure depression and anxiety levels. When a patient scores more than eight points from the total of 21 points, the patient likely has a case of depression or anxiety depending on the subscale with the score.

As aforementioned, understanding the sleep quality among patients is critical in improving their QoL. As such, tools such as Pittsburgh Sleep Quality Index Questionnaire (PSQI) play a role in assessing the presence of sleep disturbances. In the scoring of PSQI, seven components are evaluated based on their level of difficulty. The final score is evaluated based on a range of 0 to 21 with higher scores indicating poor quality of sleep. According to Backhaus et al., the PSQI has a high test-retest reliability and has good validity for patients experiencing primary insomnia. The tool measures the disturbances and quality of patients' sleep in the clinical population for one month. The PSQI contains seven elements: sleep duration, sleep latency, subjective sleep quality, sleep disturbances, daytime dysfunction, and habitual sleep efficiency.

In addition to sleep quality, social relationships are an essential aspect of QoL. As such, measures like the Community Integration Questionnaire (CIQ) measure the ability of an individual to interact, integrate, and develop relations with people in the society. Integration is defined broadly in social networks, home, school, employment, or volunteering work. According to Hirsh et al., the CIQ measurement entails a 15-item inventory which is used to measure the levels of community integration of individuals.
who have recently suffered brain injuries. The overall questionnaire score ranges from 0 to 29, however it can be further divided into three sub-scores, corresponding to integration in the home, social integration, and productivity. Higher scores indicate higher integration and social support.

2.4.2 Measuring Health-Related Quality of Life

2.4.2.1 Direct Preference Elicitation Techniques

While the previously mentioned questionnaires exist to measure different correlates of QoL, HRQoL can be measured through a different set of means. HRQoL can be measured using direct preference elicitation techniques like the time trade-off (TTO), standard gamble (SG), and visual analog scale (VAS), with many users preferring these techniques owing to their precision, reliability, ease of use, validity, and subjectivity. These techniques produce utility scores which, in turn, can provide value to one’s HRQoL. These scores generally take on values between 0 and 1, which reflects the HRQoL of an individual. A value of 0 represents a state equal to being dead, while 1 represents a state of being in full health. Utility values are based on the normative rational decision-making model under uncertainty. Utility scores explore the preference and desirability that people express for their condition and health status.

The TTO approach seeks to elicit a response from an individual on the trade-offs they are willing to make between one’s QoL and the length of one’s life. The patients are asked about the proportion of their lives that they are willing to sacrifice to lead a healthy life or be relieved of the health issue they face. The TTO approach is the preferred method to evaluate the value of a health state in time. The use of TTO is
mainly attributed to the widespread use of EuroQol-5D (EQ-5D) instruments, where the value sets are typically obtained from the TTO. The TTO is also used by early predecessors of EQ-5D tools such as the Assessment of Quality of Life-8D (AQol-8D) and its earlier versions.

The SG approach measures the risk levels that individuals are willing to take for the treatment to help realize optimal health. In framing the SG method, participants are required to consider the choice between two options. In the first option, the respondent is asked whether they are willing to live with a certain health problem under evaluation for the remaining parts of their lives. In the second option, a risky treatment is initiated with two possible results, including optimal health with a probability of p and immediate death which has a probability of 1-p.

The VAS is considered a reliable, valid, and responsive tool that measures the QoL compared to the other assessment tools. Using the VAS, individuals must indicate where on the scale they consider their health state to be. At the top of the scale is a state of perfect health, while at the bottom is a state of the worst possible health state. However, VAS is generally considered inferior to the TTO and SG methods because the VAS involves a rating task rather than a choice task. Moreover, the VAS is also criticized because of scaling biases like the end-of-sale bias, where participants are less likely to indicate health states at the top or bottom ends of the scales.

2.4.2.2 Generic Preference-Based Measures of Health

In addition to these preference elicitation techniques, generic preference-based measures (GPBMs) of health are commonly used to measure HRQoL. EQ-5D is a widely adopted tool that measures QoL with a focus on five dimensions such as self-care,
mobility, discomfort/pain, depression/anxiety, and usual activities \(^{29}\). The tool is critical as it helps inform decision-making by organizations, providers, and healthcare authorities. According to Fransen and Edmonds \(^{30}\), the EQ-5D measurement has a high level of reliability which is sufficient for aggregate data level and is comparable to the SF-36. The scores for EQ-5D scores range between -0.59 and one where scores closer to one indicate a higher QoL, while scores less than 0 indicate states worse than death \(^{31}\).

The 36-Item Short Form Survey (SF-36) health survey is a standardized questionnaire used to assess patient health across eight dimensions: physical functioning, role limitations due to physical problems, general health perceptions, vitality, social functioning, role limitations due to emotional problems, general mental health, and health transition \(^{32}\). The questionnaire consists of items or questions that present respondents with choices about their perception of their health. The SF-36 does not lend itself to the generation of an overall summary score however, each dimension score is transformed onto a 0 to 100 scale, which is not comparable across dimensions \(^{33}\). Higher scores represent higher HRQoL. A physical component score (PCS) and mental component score (MCS) can also be derived from the scale items \(^{32}\). The Short-form Six-Dimension (SF-6D) is derived from the SF-36, covering six dimensions: role limitation, physical function, pain, social functioning, vitality, and mental functioning. The scoring for SF-6D is derived from six dimensions, including role limitations, mental health and vitality, physical functioning, pain, and social functioning. The scoring criteria use weights obtained from a sample of the general population within the UK derived using the SG method. The SF-6D method exhibits a high level of test-retest reliability \(^{34}\). On the other hand, 12-Item Short Form Survey (SF-12) is a self-reported measure that explores the effect of health on the life of individuals in the society to measure the QoL. Scoring using
the SF-12 scale is conducted based on 0 to 100 criteria, with higher scores being an indicator of better mental and physical functioning. A score of 42 and below on the SF-12 is an indicator of clinical depression. Based on previous studies, the SF-12 exhibits high reliability and validity levels in measuring health status among the elderly.

The Health Utilities Index (HUI) questionnaire is a preference-based system and health profile that measure an individual's health status, reports HRQoL, and generates utility scores. HUI entails the HUI mark 1, 2, and 3. The HUI2 investigates the concept of self-care in depth. This presents an evident benefit in a variety of applications, including the therapy of Alzheimer's disease. The HUI2 measurement criteria include seven elements: self-care, pain, mobility, emotion, cognition, sensation, and fertility – each with three to five levels. The concepts of fear and anxiety are at the core of HUI2's interpretation of the emotional experience. The HUI3 evaluates eight aspects of health, including vision, emotion, ambulation, pain, hearing, speech, dexterity, cognition, and discomfort with each characteristic having between five and six tiers. The various traits and levels may be combined to produce 972,000 distinct health states. The HRQoL score is determined using the utility function from preference scores measured according to the von Neumann-Morganstern utility theory.

2.4.3 Measuring Vision-Related Quality of Life

On the other hand, vision-specific instruments such as the Visual Function Index (VF-14), National Eye Institute Visual Function Questionnaire (NEI VFQ), Activities of Daily Visual Scale (ADVS), and Visual Activities Questionnaire (VAQ) are designed to measure the impact of visual functioning on patients. They are instrumental as they help provide tools for comparison and greater sensitivity to the QoL related to patients' vision.
Visual acuity can be converted to utility values as the values from ocular diseases shows a strong correlation with visual acuity. The VAQ is a measure of low vision impairments that can impact daily living in various categories, including visual acuity, visual search, peripheral vision, and color vision. The original VAQ consists of 33 questions and eight subscales. The Visual Function Index (VF-14) is a short questionnaire that measures functional impairment in cataract patients. It comprises 18 questions that address 14 elements of visual function that are impacted by cataracts. The VF-14 has a good level of internal consistency and is a valid, reliable tool that provides information not communicated by measurements of visual acuity or general health condition. The Activities of Daily Vision Scale (ADVS) was designed as a self-report questionnaire to assess the necessity for surgery and the results following surgery in cataract patients.

The National Eye Institute Visual Function Questionnaire (NEI VFQ) measures the perceptions of self-reported vision-targeted health status, most significant for people experiencing chronic eye diseases. In particular, the 25-item version of the National Eye Institute Visual Function Questionnaire (NEI VFQ-25) presents reliable and valid criteria to assess the influence of visual impairments on HRQoL. The content for NEI VFQ-25 is derived from the focus groups with multiple conditions. The NEI VFQ-25 includes multi-item subscales to rate overall health on a 5-level scale that ranges from excellent to poor and overall vision on a 6-level scale that ranges from excellent to blind. It also includes multi-item subscales to assess difficulty with near vision activities, difficulty with distance vision activities, limitations in social functioning due to vision, role limitations due to vision, dependency on others due to vision, mental health symptoms due to vision, future expectations for vision, driving difficulties, and pain and discomfort in or around the eyes. Finally, the NEI VFQ-25 also includes single items to assess
limitations with peripheral vision and color vision. All subscales and the total questionnaire score are scored from 0 to 100. On this scale, 100 is the best possible score and higher scores indicate higher levels of VRQoL while 0 represents the worst possible score and lower scores indicate lower levels of VRQoL. 

2.5 Quality of life during COVID-19

The COVID-19 outbreak caused untold suffering from families and individuals in families as lockdowns, curfews, and social distancing rules were adopted, resulting in loss of employment and job opportunities and depression, anxiety, and isolation. The many health protocols exacerbated the loss of a family member or a friend, the anxiety of getting infected, and the stress from all these events affected the lives of many individuals. The restriction on movements resulted in an increased sedentary life, low physical activity, and conflicts in homes. Moreover, during the pandemic families grappled with the loss of their friends or relatives, freedom of movement, ability to provide, and negative impact on mental health. These events reflect the general health and HRQoL of people in the society during the pandemic conditions.

However, it should also be noted that studies showed that masks played an integral role in reducing the stress and fear among the population, while information about medical treatment, healthy lifestyles, and keeping contact helped eliminate anxiety. Understanding the measures that individuals take to eliminate stress is critical in helping society make better decisions in the future. Furthermore, QoL is a crucial indicator of insistence in individuals' well-being and overall health. Studies show that COVID-19 impacted the health domains of individuals, including social functioning,
physical condition, and health domains. For instance, the implementation of preventive measures affected the ability of individuals to care for their families, health, and well-being as they were unable to exercise or access basic needs such as food and medication.

2.6 Quality of Life of Seniors aged 65+

The QoL for older adults, especially those above 65 years of age, appeared to be affected heavily as social distancing, isolation, and loss of physical contact with their guardians and family members increased loneliness and anxiety. Since the older people are a vulnerable population, they were scarcely visited by the healthy younger population resulting in isolation and depression. The elderly in rehabilitation homes and those confined in their homes away from their relatives experienced a low QoL.

In general, older people describe a high QoL as being healthy, having peace, living in harmony, feeling happy, being satisfied with life, and keeping oneself busy, whether with hobbies, volunteer service, or work. It also meant preserving interpersonal relationships and receiving support from family, friends, and neighbors. In a study by Emrani et al., utility scores using the EQ-5D of older individuals without a spouse, either divorced or widowed, were significantly lower than married individuals. Thus, the research indicates a higher quality perception of life by individuals as one with a high support system, either from spouses or friends.

2.7 Quality of life of people with eye diseases

Loss of vision affects the QoL of a person and their functions as they are unable to care for themselves and family members. People's QoL with eye diseases is lower as mental health and mood are affected. Patients suffering from eye diseases also tend to
experience short sleep duration, insomnia, poor sleep quality, sleep disorders, and sleep apnea. Sleep disorders increase stress levels as hormones such as cortisol cause dehydration. Sleep latency and quality are critical elements in sleep, disrupted by eye diseases. Ultimately, individuals with eye diseases experience lower cognitive control and functions that reduce their QoL.

The HRQoL for an individual with peripheral vision loss is known for diseases like glaucoma affecting the peripheral vision. Additionally, HRQoL in diseases like age-related macular degeneration (ARMD) and cataracts affect central vision is also known. Both peripheral and central vision loss appear to negatively impact QoL to a similar extent. The relationship between QoL and various eye diseases is essential to understand in clinical practice when assessing the visual function, the patient's well-being, and level of satisfaction with their care. Thus, as glaucoma severity increases, the impacts of HRQoL rise in a similar fashion. In addition, patients with cataracts also exhibit a low VRQoL. According to a study by Amedo et al., cataract surgery improves the VRQoL in many aspects, including enhanced engagement in social activities and elimination of limitations to work-related activities. Furthermore, dry eye disease (DED) is a significant public health problem that causes ocular pain, tiredness, and visual disturbances that negatively impact QoL, including social, physical, and psychological functioning, daily activities, and professional productivity. Finally, Slakter and Stur acknowledge that ARMD can significantly affect QoL. They also establish that growing vision loss is connected with a worsening of QoL, and that vision loss is a common cause of depression.
2.8 Gaps in the Literature and the Objectives of the Thesis

Despite numerous studies exploring the impact of eye diseases on the QoL of patients with eye diseases, there is yet to be a study that summarizes the HRQoL of patients with various eye diseases in terms of measures such as direct preference elicitation techniques and GPBMs. Moreover, despite numerous studies exploring the impact of COVID-19 on the QoL of people in society, no research has been conducted on the effects of COVID-19 on the QoL for seniors with eye diseases after the health protocols were introduced.

Thus, this thesis aims to explore the HRQoL of patients with various eye diseases evaluated using direct preference elicitation techniques and GPBMs, to provide important information to policymakers to make evaluations and resource allocation decisions. Moreover, this thesis aims to characterize the HRQoL, VRQoL, depression and anxiety symptoms, sleep quality, and social support and community integration of seniors aged 65 and above with various eye diseases during the COVID-19 pandemic. This thesis strives to improve patients' overall care for eye diseases through accomplishing these aims.
2.9 References


Chapter 3 Health-related Quality of Life of North American Patients with Eye Diseases

3 Abstract

**Background:** Health-related Quality of Life (HRQoL) values determined using direct elicitation methods and generic preference-based measures are important for economic evaluations of healthcare interventions.

**Objective:** This study systematically identifies and summarizes the HRQoL of patients with a variety of eye diseases.

**Methods:** A systematic review of the literature identified North American studies that quantified HRQoL of eye disease patients. Database searches were conducted through MEDLINE, EMBASE, National Institute for Health Research Economic Evaluation Database, Cochrane Libraries, and Web of Science. Risk of Bias Assessment was performed using the assessment tools by CLARITY Group of McMaster University.

**Results:** Of the 3481 articles identified, 39 articles met the inclusion criteria. The time trade-off technique was used in nine of the included studies, while the SG technique was used in two studies. Fifteen studies used the SF-36, five studies used the SF-12, and 3 studies used the SF-6D. Two studies used the HUI2, and three studies used the HUI3. Fourteen studies used the EQ-5D. Utility values across collective patients with glaucoma, age-related macular degeneration (ARMD), diabetic retinopathy (DR), cataracts, uveitis, and dry eye disease (DED) ranged from 0.89 to 0.94, 0.74 to 0.81, 0.77 to 0.88, 0.66 to 0.85, 0.67 to 0.84, and 0.78 to 0.82, respectively.
Conclusions: HRQoL across patients with glaucoma, ARMD, DR, cataracts, uveitis, and DED was similar using the SF-12 and SF-36. Utility values across patients with ARMD, DR, uveitis, and DED appear to be similar while the values in patients with glaucoma appear to be higher.

3.1 Introduction

A commonly used definition of health is that “Health is a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity” provided by the World Health Organization. An important feature of health is that it includes domains such as pain, feelings, and various other symptoms that are experienced by an individual. A similarly related concept to health is health-related quality of life (HRQoL).

HRQoL can be defined as how well a person functions in their daily life and their perceived wellbeing across physical, mental, and social domains of health. Here, functioning refers to a person’s ability to perform some pre-defined activities, while wellbeing refers to a person’s subjective feelings. Moreover, HRQoL also refers to aspects of self-perceived well-being that are related to the presence of disease or response to treatment. This definition is sometimes stated in a narrower version, where HRQoL is used to identify the sub-set of the important or most common ways in which health or health care impacts a person’s well-being. However, HRQoL can also be defined in terms of the level of health as perceived by the individual experiencing the health state. These values are also known as utilities and are used to calculate quality-adjusted life-years (QALYs) which can be used to measure the benefits of health technologies.
general, utility values are on a scale where zero is equal to death and one is equal to full health. Values less than one are meant to reflect the loss of quality of life (QoL) because of living in ill health\textsuperscript{7}.

The standard gamble (SG), time trade-off (TTO), and the visual analogue scale (VAS) are three main techniques for valuing health states, often called direct preference elicitation techniques\textsuperscript{2,8}. However, in addition to these preference elicitation techniques, generic preference-based measures (GPBM) of health are also commonly used methods for measuring health states\textsuperscript{2,8}. These GPBM frequently make use of the direct preference elicitation techniques above to estimate utility values for each health state defined by the GBPM. GPBM are relatively simple to use and widely accepted by policymakers concerned with using economic assessments of cost-effectiveness around the world.

There are a number of GPBM used in practice, and they all have a description of health status and a set of values to assign to each health state defined by the descriptive system. Each measure has a health state classification with multilevel dimensions that together describe many health states. From these questionnaires, a preference-based single utility value can be generated, which is estimated from a survey of the general population who were asked to provide values for a set of states defined by the instrument. These measures are designed to be relevant to most patient groups including the general population and provide a means of making comparisons across different disease areas.\textsuperscript{2} Some of the most well-known GPBM include the EuroQol-5D (EQ-5D), Short-form Six-Dimension (SF-6D), 36-Item Short Form Survey Instrument (SF-36), 12-Item Short Form Survey (SF-12), and Health Utilities Index (HUI) questionnaires.
Eye diseases and ophthalmological conditions can have a negative impact on one’s HRQoL. However, their effect on one’s HRQoL can vary depending on the eye disease and one’s visual acuity\textsuperscript{9,10}. A previous systematic review noted that using utility values that decreased visual acuity levels tend to have an obvious negative impact on the HRQoL in patients with diabetic retinopathy (DR) and age-related macular degeneration (ARMD)\textsuperscript{11}. Another systematic review previously noted that the impact of glaucoma and ARMD on QoL was similar across most domains of the SF-36. However, it appeared that the weighted mean scores across the “role limitations caused by physical problems” and “general health” domains appeared to be lower among patients with ARMD while the score across the “social functioning” domain appeared to be lower in patients with glaucoma\textsuperscript{12}. While these previous systematic reviews provide important insight on the HRQoL of patients with these eye diseases, they tend to focus on specific eye conditions. In short, there is need for a comprehensive review that identified HRQoL across all eye conditions, using either direct or indirect elicitation methods.

In performing a systematic review to explore the QoL of patients in a variety of eye diseases evaluated using preference elicitation techniques and GPBMs, we will be able to inform economic evaluations and resource allocation decisions, and, ultimately, improve the overall care of patients with different eye diseases. As such, the purpose of this current systematic review is to systematically identify studies reporting the values of HRQoL of patients with eye diseases from North America. This was accomplished by summarizing summary scores and utility values reported for eye disease patients.
3.2 Methods

A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statements.13

3.2.1 Data sources and searches

Database searches were conducted through MEDLINE, EMBASE, National Institute for Health Research Economic Evaluation Database (NHS EED), Cochrane Libraries, and Web of Science. In both MEDLINE and EMBASE, search strategies were designed to retrieve pertinent articles up to January 28, 2022. In NHS EED, Cochrane Library, and Web of Science search strategies were designed to retrieve pertinent articles up to February 6, 2022.

The search strategies were designed to include various keywords, terms, and subject headings synonymous with the following concepts: quality of life, time trade-off, visual analog scale, standard gamble, and eye disease. GPBMs including the EQ-5D, SF-36, SF-12, SF-6D, and HUI was used as search terms. Additionally, specific eye diseases including glaucoma, retinal vein occlusion, cataracts, macular degeneration, macular edema, macular hole, retinal detachment, dry eye disease (DED), thyroid eye disease, amblyopia, strabismus, and uveitis were used as search terms. Full search strategies for each database can be found in Appendix H.

3.2.2 Inclusion/Exclusion criteria

We included any type of observational and experimental study performed in North America on adults (18 years and older) clinically diagnosed with any type of eye disease. We included studies using direct preference elicitation methods of time trade-off or
standard gamble or studies using the EQ-5D, SF-6D, SF-36, SF-12, or HUI questionnaires to evaluate HRQoL. We included studies that provided utility scores or summary scores from the direct elicitation methods or GPBMS mentioned above for the reported eye diseases. However, studies were required to have an English full text.

3.2.3 Screening and Selection of studies

The results found through the database searches were imported into Covidence systematic review software (Covidence, Inc)\(^1\)\(^4\). Duplicates were removed, and systematic screening was done by two independent reviewers (B.Y and H.J). Level one (title and abstract) screening occurred first, and Cohen’s Kappa statistics and raw percentage agreement were calculated before conflicts were resolved. Conflicts at each level of screening were resolved by consensus. If consensus could not be reached, then a third reviewer was required to arbitrate. The remaining studies then proceeded to level two (full text) screening where their full texts had been uploaded and Cohen’s Kappa statistics and raw percentage agreement were calculated, once again, following the screening process.

3.2.4 Risk of Bias (RoB) Assessment

The Risk of Bias (RoB) assessment tools by CLARITY Group of McMaster University was used to assess the risk of bias in the included studies\(^1\)\(^5\). Given the variation in study design, we employed a number of quality tools based on the type of study. Specifically, the Instrument for Cross-Sectional Surveys of Attitudes and Practices, Tool to Assess Risk of Bias in Cohort Studies, Tool to Assess Risk of Bias in Randomized Controlled Trials, and Tool to Assess Risk of Bias in Longitudinal Symptom Research
Studies Aimed at the General Population were all chosen as the tools to assess the study quality.

3.2.5 Data extraction

Data extraction was completed by two independent reviewers (B.Y and T.W) onto standardized data sheets that were checked for accuracy by two other independent reviewers (S.A and M.M). Information extracted from the studies included author(s) names, study year, publication, study design, geographical location of study, study objectives, study period and duration, sampling methods, total sample size, and study settings. Additionally, information pertaining to the participants of the studies including gender, age, eye diseases, non-ocular comorbidities, visual acuity, education level, as well as race/ethnicity were also extracted. Finally, information on the questionnaires and elicitation methods used, mode of administration, domain scores, summary scores, and utility scores of the elicitation methods were also extracted. The outcome data of all studies pertaining to the Multicenter Uveitis Steroid Treatment (MUST) trial were merged as one to prevent the duplication of study data.16–18 Similarly, the outcome data of the studies by Feeny et al.19 and Groessl et al.20 were also merged to prevent the duplication of study data.

3.2.6 Data Synthesis

All included studies were described qualitatively in terms of the study and participant characteristics, elicitation methods used, and HRQoL scores across each eye disease.
3.3 Results

The flow of literature is represented in the PRISMA flowchart (Figure 3-1). The search strategy resulted in 5856 records that were potentially relevant to the review including from 1246 MEDLINE, 3114 from EMBASE, 160 from NHS EED, 653 from Cochrane Libraries, and 683 from Web of Science. After the removal of duplicates, 3481 records remained and were then subject to level one screening. After the two independent reviewers completed level one screening, 3012 records were removed as they did not contain relevant information pertaining to QoL in patients with eye diseases. This resulted in 469 records remaining and sought for retrieval; however, 11 reports were irretrievable. As such, 458 reports then proceeded on to level two screening. 419 reports were then excluded leaving 39 reports. The reasons for excluding the 419 reports are listed in Figure 3-1.

The Cohen’s Kappa statistics for level one and level two screening were 0.73 and 0.58, respectively (Appendix I). These scores indicate substantial and moderate agreement respectively. However, of note, the raw percentage agreement scores for level one and level two screening were 94% and 90%, respectively.

3.3.1 Characteristics of Included Studies

The characteristics of the included studies can be seen in Table 1 and the characteristics of the participants in the included studies can be seen in Table 2. Of the total 39 included studies, 10 were from Canada, 21 were from the United States of America (USA), and one included participants from both Canada and the USA. The remaining seven studies included countries outside of North America, in addition to
either Canada, the USA, or both\textsuperscript{16–18,52–55}. Twenty-two studies followed a cross-sectional study design\textsuperscript{22,25,28–31,33,35–40,42,45,47,49–53,55}. Four studies had a cohort design\textsuperscript{24,26,32,48} while six studies followed a longitudinal survey design\textsuperscript{19,20,23,27,34,43}. Seven studies followed a randomized controlled trial (RCT) design\textsuperscript{16–18,41,44,46,54}. Of the 22 studies that followed a cross-sectional design, 3 of the studies were abstract-only publications\textsuperscript{22,30,42}. The TTO technique was used in nine of the included studies\textsuperscript{29–31,34–37,49,50}, while the SG technique was used in two studies\textsuperscript{35,36}. Sixteen studies used the SF-36\textsuperscript{16–18,23,25,27,32,42–45,47,48,51,52,54}, five studies used the SF-12\textsuperscript{25,33,38,40,41}, and 3 studies used the SF-6D\textsuperscript{19,20,54}. Two studies used the HUI2\textsuperscript{19,20}, and three studies used the HUI3\textsuperscript{19,20,22}. Finally, 14 studies used the EQ-5D\textsuperscript{16–20,24,26,28,39,46,51,53–55}.

The mode of administration was self-administered in 19 studies\textsuperscript{16–}
\textsuperscript{20,25,27,32,33,35,39,41,42,44,50,51,53,55,56}, interviewer-administered in 12 studies\textsuperscript{23,26,29,30,34,36–}
\textsuperscript{38,40,46,47,52}, and self-administered using an assistant in two studies\textsuperscript{28,31}. Seven of the included studies focused on patients with glaucoma\textsuperscript{28,30–33,40,44}. Eight studies focused on patients with ARMD\textsuperscript{25,27,36–38,47,50,55}. Seven studies focused on patients with DR\textsuperscript{25,29,30,35,37,43,45}. Six studies focused on patients with cataracts\textsuperscript{19,20,23,26,41,48}. Five studies focused on DED\textsuperscript{39,42,49,51,53}. Five studies focused on patients with uveitis\textsuperscript{16–18,24,54} and one each on patients with retinal vein occlusion\textsuperscript{22}, strabismus\textsuperscript{34}, diabetic macular edema\textsuperscript{46}, posterior vitreous detachment\textsuperscript{25}, and retinal detachment\textsuperscript{25}.

3.3.2 Risk of Bias Assessment

The results of the RoB assessment can be seen in Appendix C. Of the 22 studies using a cross-sectional design assessed using the Instrument for Cross-Sectional Surveys of Attitudes and Practices, 10 studies were deemed to be of low risk\textsuperscript{25,28,29,31,35–38,40,53}, nine
studies were deemed to be of moderate risk\textsuperscript{33,39,45,47,49–52,55}, and three were deemed to be of high risk\textsuperscript{22,30,42}. All five studies using a cohort design assessed by the Tool to Assess Risk of Bias in Cohort Studies were deemed to be of moderate risk\textsuperscript{18,24,26,32,48}. Of the five studies using a RCT design assessed using the Tool to Assess Risk of Bias in Randomized Controlled Trials, one study was deemed to be of low risk\textsuperscript{46}, three studies were deemed to be of moderate risk\textsuperscript{41,44,54}, and one study was deemed to be of high risk\textsuperscript{17}. Finally, of the seven studies using a longitudinal survey design assessed using the Tool to Assess Risk of Bias in Longitudinal Symptom Research Studies Aimed at the General Population, five studies were deemed to be of low risk\textsuperscript{16,20,23,27,43}, one study was deemed to be of moderate risk\textsuperscript{19}, and one study was deemed to be of high risk\textsuperscript{34}.

3.3.3 HRQoL in Patients with Glaucoma

Table 3-3a presents the outcome data in studies pertaining to patients with glaucoma. In the seven studies focused on patients with glaucoma, there were two studies with a specific focus on primary open-angle glaucoma (POAG), four of the studies focused on glaucoma in general, and the remaining one investigated open-angle glaucoma (OAG).

There was a total of three different GPBMs that were used in the studies pertaining to patients with glaucoma (Table 3-3a.). The SF-12 was used in two studies, the SF-36 was used in two studies, and the EQ-5D 5L was used in one study. Moreover, there were two studies that applied the TTO elicitation technique. Using the SF-12, Balkrishanan et al.\textsuperscript{33} similarly reported a mean (SD) of 39.9 (12.0) for the PCS and 52.2 (9.9) for the MCS for all patients in their study. Serbin et al.\textsuperscript{40} also used the SF-12, however they demonstrated a mean (SD) of 41.8 (12.6) for the PCS and 52.2 (9.9) for the
MCS for all patients in their study. Serbin et al.\textsuperscript{40} also reported the PCS and MCS by patients with and without select physical or mental comorbidity (SPMC) noting that the scores were higher among patients without SPMC. The study by Bailey et al.\textsuperscript{32} reported a mean (SD) of 45.6 (10.6) for the physical component score (PCS) and 54.2 (7.4) for the mental component score (MCS) using the SF-36 for all patients in their study. Javitt et al.\textsuperscript{44} used the SF-36 and reported baseline means and ranges for the PCS and MCS by treatment group. In the brimonidine group, the mean PCS is 52.4 and its range is 23.5 to 64.7 while the mean MCS is 63.1 and its range is 38.7 to 74.8. Similarly, in the timolol group, the mean PCS is 53.8 and its range is 21.4 to 64.0 while the mean MCS is 62.9 and its range is 32.2 to 73.8.

The study by Montemayor et al.\textsuperscript{28}, showed a mean utility score of 0.89 with a range from -0.08 to 1.00 using the EQ-5D 5L for all patients in their study. Finally, using the TTO method, Thomas et al.\textsuperscript{30} demonstrated a mean (SD) utility score of 0.94 (0.15) for patients with glaucoma while Uruthirimooorthy et al.\textsuperscript{31} reported a mean (SD) utility score of 0.91 (0.18) for all patients through also using the TTO method.

Overall, based on the SF-12, the mean PCS values ranged from 39.2 to 44.67 and the mean MCS values ranged from 48.7 to 52.2. Based on the SF-36, the mean PCS values ranged from 45.6 to 53.8 and the mean MCS values ranged from 54.2 to 63.1. These scores generally suggest average physical health and mental health among patients with glaucoma. The mean utility values of patients with glaucoma were between 0.89 to 0.94. However, these scores appear to suggest a good HRQoL among patients with glaucoma.
3.3.4 HRQoL in Patients with Age-related Macular Degeneration

Table 3-3b presents the outcome data in studies pertaining to patients with ARMD. Analysis of ARMD was covered in eight studies with a total of 1295 respondents. Seven of the studies focused on ARMD in general, while one study focused specifically on wet ARMD.

Of the eight studies focused on ARMD, two used the SF-12, three used the SF-36, and one used the EQ-5D (Table 3-3b). In terms of the direct preference elicitation methods that were used, three studies used the TTO, and one study used the SG. The study by Choudhury et al.\textsuperscript{38} presented mean PCS and MCS scores by disease severity using the SF-12. Patients with early ARMD had mean a PCS and MCS of 46.8 (95% CI: 42.2, 51.4) and 49.8 (95% CI: 44.2, 55.2) respectively. Similarly, patients with late ARMD group had a mean PCS and MCS of 44.0 (95% CI: 38.1, 49.8) and 50.9 (95% CI: 43.9, 58.0) respectively\textsuperscript{38}. Globe et al.\textsuperscript{25} presented PCS and MCS scores for all patients using both the SF-12 and SF-36. The SF-12 found a mean (SD) PCS of 46.0 (11.0) and a mean (SD) MCS of 50.0 (12.0) while the SF-36 found a mean (SD) PCS of 45.0 (10.0) and a mean (SD) MCS of 50.0 (11.0)\textsuperscript{25}. Between the seven severity groups, Mackenzie et al.\textsuperscript{27} found mean PCS scores ranging from 41.0 to 47.0 and mean MCS scores ranging from 38.0 to 53.0. Mackenzie et al.\textsuperscript{27} and Mangione et al.\textsuperscript{47} both used the SF-36 and reported mean (SD) scores for each domain by disease severity which can be seen in further detail in Appendix K.

The study by Brown et al.\textsuperscript{36} showed a mean utility score of 0.72 (95% CI: 0.66, 0.78) using TTO method and 0.81 (95% CI: 0.76, 0.86) using the SG method for all patients in their study. Another study by Brown et al.\textsuperscript{37} also showed, for all study patients,
a mean (SD) utility score of 0.74 (0.23) using TTO method. Both studies by Brown et al.\textsuperscript{36} and Brown et al.\textsuperscript{37} also provide utility scores across patients grouped by visual acuity (Table 3-3b). In a study by Brown et al.\textsuperscript{36}, mean utility scores across all visual acuity groups range from 0.40 to 0.96. However, in another study by Brown et al.\textsuperscript{37}, the mean utility values range from 0.59 to 0.84. In both studies, a general trend of higher utility values with better visual acuity and lower utility values can be seen with worse visual acuity. The study by Soubrane et al.\textsuperscript{55} showed a mean utility score of 0.95 (95% CI: 0.90, 0.99) for all patients with wet ARMD. Finally, using the EQ-5D, the study by Stein et al.\textsuperscript{50} presented their results across disease severity where the mild, moderate, and severe groups had mean utility scores of 0.83 (95% CI: 0.76, 0.90), 0.73 (95% CI: 0.67, 0.80), and 0.57 (95% CI: 0.49, 0.65), respectively.

Overall, based on the SF-12, the mean PCS values ranged from 44.0 to 46.8 and the mean MCS values ranged from 49.8 to 50.9. Based on the SF-36, the mean PCS values ranged from 41.0 to 47.0 and the mean MCS values ranged from 38.0 to 52.0. These scores appear to suggest generally average physical and mental health among patients with ARMD. However, it is worth noting that the lower limits of the ranges are likely indicative of a poorer quality of physical and mental health among patients with more severe forms of ARMD. The mean utility values of patients with ARMD were between 0.40 to 0.96. Overall, these scores suggest a variable HRQoL from poor to good among patients with ARMD. However, once again, it should be noted that patients with more severe forms of ARMD or with worse visual acuity appear to have poorer HRQoL.
3.3.5 HRQoL in Patients with Diabetic Retinopathy

Table 3-3c presents the outcome data in studies pertaining to patients with DR. There were seven studies that focused on patients with DR. Out of the seven studies, one study applied both the SF-12 and SF-36, while two studies applied only the SF-36. It can also be noted that two studies applied both the TTO and SG, while the other two studies applied only the TTO.

Using the SF-12, a mean (SD) PCS of 46.0 (9.0) and a mean (SD) MCS of 51.0 (9.0) was reported. Globe et al. reported mean (SD) PCS and MCS using both the SF-12 and SF-36 for all patients in their study. Similarly, using the SF-36 a mean (SD) PCS of 46.0 (10.0) and a mean (SD) MCS of 50.0 (9.0) were also reported. The study by Hirai et al. reported mean (SD) PCS and MCS of 49.6 (9.6) and 51.6 (8.3) respectively using the SF-36 for all study patients. Furthermore, Hirai et al. also reported 10-year follow-up PCS and MCS scores of 46.2 (11.1) and 52.9 (8.9), respectively. Additionally, Hirai et al. and Lewis et al. both reported scores for each domain of the SF-36 which can be seen in further detail in Appendix K.

The study by Brown et al. showed mean utility scores of 0.77 (95% CI: 0.73, 0.81) and 0.88 (95% CI: 0.84, 0.92) using the TTO and SG methods respectively for all study patients. Another study by Brown et al. showed a utility score of 0.79 (0.20) using the TTO method for all patients with DR. Both studies by Brown et al. provided utility scores across patients grouped by visual acuity (Table 3-3c). In study by Brown et al., mean utility scores across all visual acuity groups range from 0.59 to 0.92. However, in the study by Brown et al., the mean utility values range from 0.60 to 0.86. Once again, in both studies, a general trend of higher utility values with better visual acuity and
lower utility values can be seen with worse visual acuity. Similarly, the study by Thomas et al.\textsuperscript{30} showed a mean (SD) utility score of 0.81 (0.33) and Sharma et al. showed a mean (SD) utility score of 0.79 (0.23) while both using the TTO method for all patients in their respective studies.

Overall, based on the SF-12, the mean PCS value was 46.0 and the mean MCS values ranged from 51.0. Based on the SF-36, the mean PCS values ranged from 46.2 to 46.0 and the mean MCS values ranged from 50.0 to 52.9. Overall, these scores suggest generally average physical and mental health among patients with DR. The mean utility values of patients with DR were between 0.59 to 0.92. These scores suggest a variable HRQoL from poor to good among patients with DR. However, it should be noted that patients with worse visual acuity appear to have poorer HRQoL.

3.3.6 HRQoL in Patients with Cataracts

Table 3-3d presents the outcome data in studies pertaining to patients with cataracts. One study used the SF-12, three of the studies used the SF-36, another study used the EQ-5D, HUI2, HUI3, and SF-6D, and another used only EQ-5D. Espindle et al.\textsuperscript{41} provided mean (SD) PCS and MCS by intervention group using the SF-12 at baseline prior to administering the interventions. The mean (SD) PCS and MCS were 43.2 (11.2) and 54.0 (9.1) respectively in the blue light-filtering intraocular lens (IOL) group. In the clear IOL group, the mean (SD) PCS and MCS were 43.2 (11.3) and 54.0 (9.1) respectively\textsuperscript{41}. Boisjoly et al.\textsuperscript{23} reported the median and interquartile range (IQR) PCS and MSC for two cohorts with cataracts using the SF-36. The first cohort had a median (IQR) PCS and MCS of 75.0 (50.0, 90.0) and 76.0 (56.0, 88.0) respectively, while the second cohort had a median (IQR) PCS and MCS of 75.0 (50.0, 90.0) and 76.0 (64.0,
80.0) respectively. Owsley et al. reported the baseline mean (SD) PCS and MCS across two intervention groups as well using the SF-36. In the surgery group, the mean (SD) PCS and MCS were 45.9 (14.4) and 81.2 (16.1) respectively. Similarly, in the no surgery group, the mean (SD) PCS and MCS were 45.9 (15.8) and 82.1 (11.1) respectively. Lee et al. reported mean (SD) scores for each domain in the SF-36 for all patients (Appendix K).

The study by Feeny et al. showed a mean (SD) utility score of 0.83 (0.17) for the EQ-5D, 0.79 (0.17) for the HUI2, 0.66 (0.27) for HUI3, and 0.74 (0.12) for the SF-6D for all study patients. Finally, the study by Lim et al. showed a mean (SD) utility score of 0.85 (0.14) using the EQ-5D for all patients preoperatively.

Overall, based on the SF-12, the mean PCS values ranged from 43.2 to 46.1 and the mean MCS values ranged from 54.0 to 54.6. These scores suggest generally average physical and mental health among patients with cataracts. Based on the SF-36, the central tendencies of PCS values ranged from 45.9 to 75.0 and the mean MCS values ranged from 76.0 to 82.1. These scores suggest generally average to good physical health and good mental health among patients with cataracts. The mean utility values of patients with cataracts were between 0.66 to 0.85. These scores suggest fair to good HRQoL among patients with cataracts.

### 3.3.7 HRQoL in Patients with Uveitis

Table 3-e presents the outcome data in three studies pertaining to patients with uveitis. One study by Chan et al. dealt with anterior uveitis, the other one by Naik et al. investigated uveitis in general, and the combined study by The Multicenter Uveitis
Steroid Treatment Trial Research Group\textsuperscript{16–18} dealt with intermediate uveitis and pan uveitis.

All studies in patients with uveitis applied a different variety of GPBMs. The first study by Chan et al.\textsuperscript{24} used EQ-5D (5L), the second one by Naik et al.\textsuperscript{54} applied both SF-36 and SF-6D, and the last one by The Multicenter Uveitis Steroid Treatment Trial Research Group\textsuperscript{16–18} used EQ-5D and SF-36. Naik et al.\textsuperscript{54} reported a mean (SD) PCS and MCS score of 47.4 (12.2) and 47.6 (12.7) respectively. The Multicenter Uveitis Steroid Treatment Trial Research Group\textsuperscript{16–18} reported median (IQR) PCS and MCS scores of 55.0 (45.0, 55.0) and 52.0 (40.0, 57.0) for all patients with virtually identical scores being reported among patients with intermediate and pan uveitis. Further information on each domain score from both studies can be found in Appendix K.

Among patients with anterior uveitis, the study by Chan et al.\textsuperscript{24} showed a mean (SD) utility score of 0.72 (0.21) for patients who also presented with inflammatory back pain and 0.82 (0.16) for patients without inflammatory back pain. However, the study by Naik et al.\textsuperscript{54} showed a mean (SD) utility score of 0.67 (0.11) and 0.84 (0.13) using the SF-6D and EQ-5D respectively. In addition, the Multicenter Uveitis Steroid Treatment Trial Research Group\textsuperscript{16–18} showed median (IQR) utility scores of 0.8 (0.8, 1.0) for all patients, for patients with intermediate uveitis, and for patients with pan uveitis. Further scores by stratification on follow-up time by treatment group can be found in Appendix K.

Overall, based on the SF-36, the measures of central tendency for PCS values ranged from 47.4 to 50.0 and MCS values ranged from 47.6 to 52.0. These scores suggest generally average physical and mental health among patients with uveitis. The measures
of central tendency for utility values of patients with uveitis were between 0.67 to 0.84. These scores suggest fair to good HRQoL among patients with uveitis.

3.3.8 HRQoL in Patients with Dry Eye Disease

Table 3-3f presents the outcome data in studies pertaining to patients with DED. There were five studies conducted on patients with DED. The included studies that were conducted on patients with DED used different sets of GPBMs. Two of the studies by Dana et al.\textsuperscript{39} and Messmer et al.\textsuperscript{53} used the EQ-5D 5L, the study by Farrand et al.\textsuperscript{42} used the SF-36, and lastly, the EQ-5D 3L and SF-36 were used by Rajagopalan\textsuperscript{51}. Schiffman et al.\textsuperscript{49} was the only study that used the TTO elicitation method.

The study by Farrand et al.\textsuperscript{42} reported PCS and MCS scores across patients with diagnosed DED and symptomatic participants with undiagnosed DED. The mean (SD) PCS and MCS scores were 45.3 (10.6) and 48.1 (22.4) respectively in the patients diagnosed with DED. Similarly, the mean (SD) PCS and MCS scores were 45.3 (10.6) and 48.1 (22.4) respectively in the participants who were symptomatic and undiagnosed with DED\textsuperscript{42}. Rajagopalan et al.\textsuperscript{51} showed mean (SD) PCS and MCS scores of 47.1 (0.9) and 51.0 (0.8) respectively for all patients in their study.

The study by Dana et al.\textsuperscript{39} showed a mean (SD) utility value score of 0.82 (0.13) for all patients with DED. Messmer et al.\textsuperscript{53} showed a mean utility value score of 0.78 for all patients with DED. However, the study by Rajagopalan et al.\textsuperscript{51} showed a mean (SD) utility score of 0.82 (0.02) for all their study patients. The study by Schiffman et al.\textsuperscript{49} reported mean (SD) utility scores across the severity of DED among their patients. Patients who were asymptomatic, had mild, moderate, severe, and DED requiring surgery
revealed mean (SD) scores of 0.78 (0.23), 0.81 (0.18), 0.78 (0.19), 0.72 (0.23), and 0.62 (0.26) respectively.

Overall, based on the SF-36, the mean PCS values ranged from 45.3 to 48.8 and MCS values ranged from 44.6 to 51.0. These scores suggest generally average physical and mental health among patients with DED. The mean utility values of patients with DED were between 0.62 to 0.82. These scores suggest fair to good HRQoL among patients with DED. However, it should be noted that patients with worse disease severity had lower HRQoL.

3.3.9 HRQoL in Patients with other eye diseases

The current review involved a number of other eye diseases, including central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO) in the study by Balshaw et al., diabetic macular edema (DME) in the study by Loftus et al., both posterior vitreous detachment (PVD) and retinal detachment in the study by Globe et al., and strabismus in the study by Beauchamp et al. (Table 3-3g).

The GPBMs that were applied were different as well. The HUI3 was used in the study pertaining to CRVO and BRVO, the EQ-5D (3L) was used in the study on DME, and the SF-12 and SF-36 were used in the study on PVD and retinal detachment (Table 3-3g). The study on adult strabismus by Beauchamp et al. used the TTO method. Globe et al. presented mean (SD) PCS and MCS for both the SF-12 and SF-36. Among all patients with PVD, the SF-12 showed mean (SD) PCS and MCS of 51.0 (9.0) and 52.0 (9.0) respectively. The SF-36 showed mean (SD) PCS and MCS of 51.0 (9.0) and 52.0 (9.0) respectively for patients with PVD as well. For retinal detachment, the SF-12
showed mean (SD) PCS and MCS of 49.0 (8.0) and 48.0 (11.0) respectively.
Furthermore, the SF-36 showed mean (SD) PCS and MCS of 50.0 (7.0) and 48.0 (11.0) respectively for patients with retinal detachment.

The study by Balshaw et al.\textsuperscript{22} showed a mean (SD) utility score of 0.80 (0.42) for patients with CRVO and BRVO together using the HUI3. The study by Beauchamp et al.\textsuperscript{34} showed a mean (SD) utility value score of 0.85 (0.20) using TTO method for all patients with strabismus preoperatively. Finally, the study by Loftus et al.\textsuperscript{46} presented baseline mean utility scores by treatment group for patients with DME; the Pegaptanib group had a score of 0.74 and the Sham group had a score of 0.76.
Figure 3-1. PRISMA flowchart of the study selection process.
Table 3-1. Characteristics of the included studies.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Country</th>
<th>Study Design</th>
<th>Sampling Method</th>
<th>Study Setting</th>
<th>Elicitation Method**</th>
<th>Mode of Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey 2016</td>
<td>USA</td>
<td>Prospective cohort</td>
<td>Cumulative incidence</td>
<td>Not specified</td>
<td>SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Balkrishnan 2003</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-12</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Balshaw 2012</td>
<td>Canada</td>
<td>Cross-sectional (Abstract only)</td>
<td>Not specified</td>
<td>Not specified</td>
<td>HUI3</td>
<td>Not specified</td>
</tr>
<tr>
<td>Beauchamp 2006</td>
<td>USA</td>
<td>Prospective survey and cost utility analysis</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Boisjoly 2010</td>
<td>Canada</td>
<td>Prospective survey</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Brown 1999</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO, SG</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Brown 2000</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO, SG</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Brown 2002</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Chan 2012</td>
<td>Canada</td>
<td>Retrospective cohort</td>
<td>Random</td>
<td>Community and tertiary healthcare</td>
<td>EQ-5D 5L</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Choudhury 2016</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Not specified</td>
<td>Community</td>
<td>SF-12</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Dana 2020</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Not specified</td>
<td>Community</td>
<td>EQ-5D 5L</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Espindle 2005</td>
<td>USA</td>
<td>RCT</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-12</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Farrand 2016</td>
<td>USA</td>
<td>Cross-sectional (Abstract only)</td>
<td>Not specified</td>
<td>Community</td>
<td>SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Feeneya 2012</td>
<td>USA</td>
<td>Longitudinal survey</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>EQ-5D 3L, HUI2, HUI3, SF-6D</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>Canada</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-12, SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Hirai 2012</td>
<td>USA</td>
<td>Longitudinal survey</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Not specified</td>
</tr>
<tr>
<td>Javitt 2000</td>
<td>USA</td>
<td>RCT</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Lee 2003</td>
<td>USA, Korea</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Lewis 2017</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Not specified</td>
</tr>
<tr>
<td>Lim 2021</td>
<td>Canada</td>
<td>Prospective cohort</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>EQ-5D</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Loftus 2011</td>
<td>USA</td>
<td>RCT</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>EQ-5D 3L</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Mackenzie 2002</td>
<td>Canada</td>
<td>Prospective case</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>Sampling Method</td>
<td>Setting</td>
<td>Health domains</td>
<td>Data collection method</td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>-------------------------</td>
<td>----------------------------------</td>
<td>------------------------</td>
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</tr>
<tr>
<td>Mangione 1999</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Messmer 2019</td>
<td>USA, Australia, Germany, UK</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>EQ-5D 5L</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Montemayor 2001</td>
<td>Canada</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>EQ-5D 5L</td>
<td>Self-administered with assistance in person</td>
</tr>
<tr>
<td>Naik 2013</td>
<td>USA, Canada, Brazil, Czech Republic, France, Germany, Greece, Australia, Austria, Israel, India, South Africa, Korea, Poland, Portugal, Spain, Switzerland, UK</td>
<td>RCT</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>SF-36, SF-6D, EQ-5D</td>
<td>Not specified</td>
</tr>
<tr>
<td>Owsley 2007</td>
<td>USA</td>
<td>Prospective cohort</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36</td>
<td>Not specified</td>
</tr>
<tr>
<td>Rajagopalan 2005</td>
<td>USA, Canada</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>SF-36, EQ-5D 3L</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Schiffman 2003</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO</td>
<td>Not specified</td>
</tr>
<tr>
<td>Serbin 2020</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Not specified</td>
<td>Community</td>
<td>SF-12</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Sharma 2003</td>
<td>Canada</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO</td>
<td>Interviewer-administered</td>
</tr>
<tr>
<td>Soubrane 2007</td>
<td>Canada, France, Germany, Spain, UK</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>EQ-5D</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Stein 2002</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>Convenience for ARMD, Random for general public</td>
<td>Community and Tertiary healthcare</td>
<td>TTO</td>
<td>Self-administered</td>
</tr>
<tr>
<td>The Multicenter Uveitis Steroid Treatment Trial Research Group 2015</td>
<td>USA, Canada, Australia, UK</td>
<td>RCT</td>
<td>Not specified</td>
<td>Tertiary healthcare</td>
<td>EQ-5D, SF-36</td>
<td>Self-administered</td>
</tr>
<tr>
<td>Thomas 2015</td>
<td>Canada</td>
<td>Cross-sectional</td>
<td>Convenience</td>
<td>Tertiary healthcare</td>
<td>TTO</td>
<td>Interviewer-administered</td>
</tr>
</tbody>
</table>
**EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; ARMD: age-related macular degeneration; DED: dry eye disease; USA: United States of America; UK: United Kingdom; RCT: randomized controlled trial; a: Groessl et al. was merged with this study; b: Frick et al. and Sugar et al. were merged with this study**

Table 3-2. Characteristics of the participants of the included studies.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Male: n (%)</th>
<th>Female: n (%)</th>
<th>Age</th>
<th>Sample Size</th>
<th>Education Level</th>
<th>Race/ethnicity: n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey 2016</td>
<td>Not specified</td>
<td>317 (100%)</td>
<td>Mean (SD): 64.0 (6.4)</td>
<td>317 POAG</td>
<td>Education: N (%)</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Graduate School: 28 (8.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balkrishnan 2003</td>
<td>111 (31.0%)</td>
<td>247 (69.0%)</td>
<td>Range: 65 to 89 Mean (SD): 75.8 (7.3)</td>
<td>589 POAG</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Balshaw 2012</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Range: 39 to 92 Median: 72</td>
<td>202 Total 75 CRVO 127 BRVO</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Beauchamp 2006</td>
<td>14 (40.0%)</td>
<td>21 (60.0%)</td>
<td>Range: 19 to 75 Mean: 49</td>
<td>35 Strabismus</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Boisjoly 2010</td>
<td>Cohort 1: 168 (33.0%)</td>
<td>Cohort 1: 341 (67.0%)</td>
<td>Median Cohort1: 73 Median Cohort2: 72</td>
<td>715 Cataracts 509 Cohort 1 206 Cohort 2</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Brown 1999</td>
<td>37 (38.9%)</td>
<td>58 (61.1%)</td>
<td>Range: 28 to 87 Mean (SD): 63 (11) Median: 64</td>
<td>100 Diabetic retinopathy</td>
<td>Mean (SD) number of years of formal education after kindergarten: 13.0 (3.0)</td>
<td>Not specified</td>
</tr>
<tr>
<td>Brown 2000</td>
<td>24 (33.3%)</td>
<td>48 (66.7%)</td>
<td>Range: 56 to 85 Mean: 74.4</td>
<td>80 ARMD</td>
<td>Mean (SD) number of years of education: 12.8 (3.2)</td>
<td>White: 72 (100%)</td>
</tr>
<tr>
<td>Brown 2002</td>
<td>Diabetic retinopathy: 146 Diabetic retinopathy: 188</td>
<td>Mean diabetic retinopathy:</td>
<td>617 Total 333 Diabetic retinopathy</td>
<td>Not specified</td>
<td>Diabetic retinopathy: White: 302 (90.4%) Non-white: 32 (9.6%)</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Sample Size</td>
<td>Percentage</td>
<td>ARMD: 83 (33.7%)</td>
<td>ARMD: 163 (66.3%)</td>
<td>Mean ARMD: 73.2</td>
</tr>
<tr>
<td>---------------</td>
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<td>-------------</td>
<td>------------</td>
<td>------------------</td>
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<td>-----------------</td>
</tr>
<tr>
<td>Chan 2012</td>
<td></td>
<td></td>
<td></td>
<td>Back pain: 22 (33.3%)</td>
<td>No back pain: 42 (56.0%)</td>
<td>Mean (SD): 45.6 (13.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean (SD): 51.4 (16.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choudhury 2016</td>
<td>2016</td>
<td>2001</td>
<td>(41.0%)</td>
<td>2875 (59.0%)</td>
<td>Mean (SD): 54.8 (10.7)</td>
<td>4876 Total</td>
</tr>
<tr>
<td>Dana*2020</td>
<td></td>
<td>351</td>
<td>(35.0%)</td>
<td>652 (65.0%)</td>
<td>Mean (SD): 56.0 (14.7)</td>
<td>2009 Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clear IOL: 73 (57.9%)</td>
<td>Clear IOL: 72.0 (6.14)</td>
<td>291 Cataracts</td>
</tr>
<tr>
<td>Espindle 2005</td>
<td></td>
<td>Blue Light–Filtering IOL: 36 (27.5%)</td>
<td>Clear IOL: 53 (42.1%)</td>
<td>Mean (SD): 54 (17)</td>
<td></td>
<td>74095 Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue Light–Filtering IOL: 95 (72.5%)</td>
<td>Clear IOL: 73 (57.9%)</td>
<td>Clear IOL: Mean (SD): 72.5 (6.71)</td>
<td>Clear IOL: Mean (SD): 72.0 (6.14)</td>
<td>291 Cataracts</td>
</tr>
<tr>
<td>Farrand 2016</td>
<td>2016</td>
<td>35566</td>
<td>(48.0%)</td>
<td>38529 (52.0%)</td>
<td>Mean (SD): 48 (17)</td>
<td>74095 Total</td>
</tr>
<tr>
<td>Feeny*2012</td>
<td></td>
<td>154</td>
<td>(41.0%)</td>
<td>222 (59.0%)</td>
<td>Age group: N (%) 35 to 44: 5 (1.3%) 45 to 64: 115 (30.6%) 65 to 91: 256 (68.1%)</td>
<td>536 total</td>
</tr>
<tr>
<td>Study</td>
<td>Total</td>
<td>Mean (SD)</td>
<td>Education: n (%)</td>
<td>White</td>
<td>Black</td>
<td>Hispanic</td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
<td>-----------</td>
<td>------------------</td>
<td>-------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>1081</td>
<td>55.7 (17.3)</td>
<td>Not specified</td>
<td>White: 622 (74.1%)</td>
<td>Black: 0</td>
<td>Indo-Pakistani: 36 (4.3%)</td>
</tr>
<tr>
<td>Hirai 2012</td>
<td>520</td>
<td>39.2 (9.4)</td>
<td>Mean (SD) years in school: 14.2 (2.5)</td>
<td>Unclear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Javitt 2000</td>
<td>219</td>
<td>219 OAG</td>
<td>Brimonidine:</td>
<td>Brimonidine: White: 67 (63.2%)</td>
<td>Black: 33 (31.1%)</td>
<td>Other: 6 (5.6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brimonidine:</td>
<td>Brimonidine: White: 52 (49.5%)</td>
<td>Black: 50 (47.6%)</td>
<td>Other: 3 (2.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timolol:</td>
<td>Timolol: White: 52 (49.5%)</td>
<td>Black: 50 (47.6%)</td>
<td>Other: 3 (2.9%)</td>
</tr>
<tr>
<td>Lee 2003</td>
<td>132</td>
<td>72.04 (8.19)</td>
<td>Education: n (%)</td>
<td>Not specified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lewis 2017</td>
<td>100</td>
<td>63.9 (13.9)</td>
<td>Not specified</td>
<td>White: 4 (8.0%)</td>
<td>Black: 16 (32.0%)</td>
<td>Hispanic: 29 (58.0%)</td>
</tr>
<tr>
<td>Lim 2021</td>
<td>320</td>
<td>69.07</td>
<td>Education: n (%)</td>
<td>African: 12 (3.9%)</td>
<td>Americas: 87 (27.7%)</td>
<td>Asia: 88 (28.0%)</td>
</tr>
<tr>
<td>Loftus 2011</td>
<td>260</td>
<td>62.3 (9.3)</td>
<td>Not specified</td>
<td>Pegaptanib: Caucasian/white: 104 (78.2%)</td>
<td>Asian: 13 (9.8%)</td>
<td>Black: 3 (2.3%)</td>
</tr>
<tr>
<td>Study</td>
<td>Median Age</td>
<td>Range</td>
<td>Mean (SD)</td>
<td>Diagnosis</td>
<td>Ethnicity</td>
<td>Surgery Yes (%)</td>
</tr>
<tr>
<td>------------------</td>
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<td>-----------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Mackenzie 2002</td>
<td>62</td>
<td>20 to 80</td>
<td>62.5 (10.2)</td>
<td>ARMD</td>
<td>Not specified</td>
<td>159</td>
</tr>
<tr>
<td>Mangione 1999</td>
<td>63</td>
<td>20 to 80</td>
<td>75 (9)</td>
<td>ARMD</td>
<td>Not specified</td>
<td>201</td>
</tr>
<tr>
<td>Mesmer 2019</td>
<td>64.3</td>
<td>24 to 92</td>
<td>64.3 (14.4)</td>
<td>Glaucoma</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Montemayor 2001</td>
<td>63</td>
<td>24 to 92</td>
<td>64.4 (14.3)</td>
<td>Total</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Naik 2013</td>
<td>64</td>
<td>24 to 92</td>
<td>44.6 (14.3)</td>
<td>Total</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Owsley 2007</td>
<td>63</td>
<td>24 to 92</td>
<td>75 (9)</td>
<td>Cataracts</td>
<td>45</td>
<td>81 (8)</td>
</tr>
</tbody>
</table>

Sham: Caucasian/white: 107 (84.3%)
Asian: 15 (11.8%)
Black: 2 (1.6%)
Hispanic: 3 (2.4%)
Other: 0

Sham: Caucasian/white: 107 (84.3%)
Asian: 15 (11.8%)
Black: 2 (1.6%)
Hispanic: 3 (2.4%)
Other: 0
<table>
<thead>
<tr>
<th>Study</th>
<th>Total</th>
<th>Mean (SD)</th>
<th>Range:</th>
<th>Education: n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rajagopalan* 2005</td>
<td></td>
<td></td>
<td></td>
<td>Highest level of education: n (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High school diploma or less: 23 (18%)</td>
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<td></td>
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<td></td>
<td>Some college: 47 (36%)</td>
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<tr>
<td></td>
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<td></td>
<td>College degree: 29 (22%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Graduate/postgraduate: 31 (24%)</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>103</td>
<td>22 to 89</td>
<td>210 Total 130 Non-SS KCS 32 SS 48 Controls</td>
</tr>
<tr>
<td></td>
<td>106</td>
<td></td>
<td>55.18 (15.26)</td>
<td>Caucasian: 106 (81.5%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>African American: 12 (9.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hispanic/Spanish American: 5 (3.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asian/Oriental/Pacific Islander: 6 (4.6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Other: 1 (0.8%)</td>
</tr>
<tr>
<td>Schiffman 2003</td>
<td></td>
<td></td>
<td></td>
<td>Mean (SD) number of years of education: 14.5 (2.8)</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>46</td>
<td>22 to 77</td>
<td>White: 35 (61.4%)</td>
</tr>
<tr>
<td></td>
<td>106</td>
<td></td>
<td>52.7 (13.9)</td>
<td>Black: 22 (38.6%)</td>
</tr>
<tr>
<td>Serbin 2020</td>
<td></td>
<td></td>
<td></td>
<td>Education: n (%)</td>
</tr>
<tr>
<td></td>
<td>1220</td>
<td>1708</td>
<td>65.09 (15.84)</td>
<td>No education: 21 (0.7%)</td>
</tr>
<tr>
<td></td>
<td>2982</td>
<td></td>
<td></td>
<td>≤ High school: 1243 (42.5%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 to 3 years of college: 368 (12.6%)</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>4 years of college: 250 (8.5%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt; 4 years of college: 216 (7.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unreported/not ascertained: 830 (28.3%)</td>
</tr>
<tr>
<td>Sharma 2003</td>
<td></td>
<td></td>
<td></td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>114</td>
<td>107</td>
<td>63.5 (12.5)</td>
<td>White: 217 (98.2%)</td>
</tr>
<tr>
<td></td>
<td>221</td>
<td></td>
<td></td>
<td>Other: 4 (1.8%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Median: 67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Age group: n (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 to 50: 32 (14.5%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51 to 60: 47 (21.3%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>61 to 70: 66 (29.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>71 to 80: 68 (30.8%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt; 80: 8 (3.6%)</td>
</tr>
<tr>
<td>Soubrane* 2007</td>
<td></td>
<td></td>
<td></td>
<td>872 Wet ARMD</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>260</td>
<td>53 to 95</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>872</td>
<td></td>
<td>78.1 (6.9)</td>
<td>White: 397 (99.0%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Black: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asian: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Other: 2 (0.5%)</td>
</tr>
</tbody>
</table>
ARMD: age-related macular degeneration; BRVO: branch retinal vein occlusion; CRVO: central retinal vein occlusion; DED: dry eye disease; DME: diabetic macular edema; SS: Sjögren’s Syndrome; KCS: Keratoconjunctivitis Sicca; PVD: posterior vitreous attachment; USA: United States of America; UK: United Kingdom; IOL: intraocular lens; OAG: open-angle glaucoma; POAG: primary open-angle glaucoma; SD: standard deviation; *: data only pertains to patients with the respective eye disease; a: Groessl et al. was merged with this study; b: Frick et al. and Sugar et al. were merged with this study

Table 3-3a. Health-related quality of life outcomes in patients with glaucoma.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey 2016</td>
<td>POAG</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Mean (SD) PCS: 45.6 (10.6) Mean (SD) MCS: 54.2 (7.4)</td>
</tr>
<tr>
<td>Balkrishnan 2003</td>
<td>POAG</td>
<td>SF-12</td>
<td>Not reported</td>
<td>Mean (SD) PCS: 39.3 (12.0) Mean (SD) MCS: 52.2 (9.9)</td>
</tr>
<tr>
<td>Javitt 2000</td>
<td>OAG</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Treatment group: PCS: Mean (Range) MCS: Mean (Range) Brimonidine: PCS: 52.4 (23.5 to 64.7) Timolol: PCS: 53.8 (21.4 to 64.0) MICS: 63.1 (38.7 to 74.8) MICS: 62.9 (32.2 to 73.8)</td>
</tr>
<tr>
<td>Montemayor 2001</td>
<td>Glaucoma</td>
<td>EQ-5D 5L</td>
<td>Mean (Range): 0.89 (0.08 to 1.00)</td>
<td>Not reported</td>
</tr>
</tbody>
</table>
Serbin 2020 | Glaucoma | SF-12 | Not reported | Patient group: | Patients With SPMC: | PCS: Mean (SD) | PCS: 39.22 (12.76) | MCS: Mean (SD) | MCS: 48.74 (11.22)
| | | | | All patients: | Patients Without SPMC: | PCS: 41.79 (12.55) | MCS: 50.17 (10.56) |

Thomas 2015 | Glaucoma | TTO | Mean (SD): 0.94 (0.15) | Not applicable |

Uruthiramorthy 2017 | Glaucoma | TTO | Mean (SD): 0.91 (0.18) | Not applicable |

**: EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; BCVA: best-corrected visual acuity; MCS: mental component score; PCS: physical component score; POAG: primary open-angle glaucoma; SD: standard deviation SPMC: select physical or mental comorbidity

Table 3-3b. Health-related quality of life outcomes in patients with age-related macular degeneration.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown 2000</td>
<td>ARMD</td>
<td>TTO, SG</td>
<td>Visual acuity: n (%) Mean (95% CI)</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All patients: 72 (100%) TTO: 0.72 (0.66, 0.78) SG: 0.81 (0.76, 0.86)</td>
<td>20/60 to 20/100: 11 (15.3%) TTO: 0.57 (0.47, 0.67) SG: 0.69 (0.52, 0.86)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20/20 to 20/25: 21 (29.2%) TTO: 0.89 (0.82, 0.96) SG: 0.96 (0.92, 1.00)</td>
<td>20/200 to 20/400: 12 (16.7%) TTO: 0.52 (0.38, 0.66) SG: 0.71 (0.57, 0.85)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20/30 to 20/50: 23 (31.9%) TTO: 0.81 (0.73, 0.89) SG: 0.88 (0.83, 0.93)</td>
<td>CF to LP: 4 (4.2%) TTO: 0.40 (0.29, 0.50) SG: 0.55 (0.36, 0.74)</td>
</tr>
<tr>
<td>Brown 2002</td>
<td>ARMD</td>
<td>TTO</td>
<td>Visual acuity: n (%) Mean (SD)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Study</td>
<td>Disease</td>
<td>Measure</td>
<td>Questionnaire</td>
<td>Results</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Choudhury 2016</td>
<td>ARMD</td>
<td>SF-12</td>
<td>Not reported</td>
<td>All patients: 263 (100%) 0.74 (0.23) to 20/50 to 20/100: 57 (21.7%) 0.71 (0.22)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20/20 to 20/25: 60 (22.8%) 0.84 (0.21) to ≤ 20/200: 65 (24.7%) 0.59 (0.22)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20/30 to 20/40: 65 (24.7%) 0.80 (0.19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Early ARMD: Mean (95% CI) PCS: 46.8 (42.2, 51.4)MSC: 49.8 (44.2, 55.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Late ARMD: Mean (95% CI) PCS: 44.0 (38.1, 49.8)MCS: 50.9 (43.9, 58.0)</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>ARMD</td>
<td>SF-12, SF-36</td>
<td>Not reported</td>
<td>SF-12: Mean (SD) PCS: 46 (11)MCS: 50 (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Mean (SD) PCS: 45 (10)MCS: 50 (11)</td>
</tr>
<tr>
<td>Mackenzie 2002</td>
<td>ARMD</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Severity of ARMD: Grade 1: PCS: 47 (10)MCS: 49 (12)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Grade 2: PCS: 46 (11)MCS: 53 (12)</td>
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<td></td>
<td>Grade 3: PCS: 46 (11)MCS: 50 (11)</td>
</tr>
<tr>
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<td></td>
<td>Grade 4: PCS: 47 (7.5)MCS: 52 (8.5)</td>
</tr>
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<td></td>
<td>Grade 5: PCS: 44 (13)MCS: 38 (16)</td>
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<td>Grade 6: PCS: 41 (15)MCS: 52 (10)</td>
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<td></td>
<td></td>
<td>Grade 7: PCS: 42 (13)MCS: 51 (9)</td>
</tr>
<tr>
<td>Soubrane 2007</td>
<td>Wet ARMD</td>
<td>EQ-5D</td>
<td>Mean (95% CI): 0.95 (0.90, 0.99)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Stein 2002</td>
<td>ARMD</td>
<td>TTO</td>
<td>Severity of ARMD: n Mean (95%CI)</td>
<td>Moderate ARMD: 47 (40.9%) 0.732 (0.669, 0.795)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mild ARMD: 34 (29.6%) 0.832 (0.762, 0.901)</td>
<td>Severe ARMD: 37 (32.2%) 0.566 (0.487, 0.645)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**: EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; CI: confidence interval; MCS: mental component score; PCS: physical component score; SD: standard deviation
<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown 1999</td>
<td>Diabetic retinopathy</td>
<td>TTO, SG</td>
<td>Visual acuity: n (%)&lt;br&gt;TTO: mean (95%CI)&lt;br&gt;SG: mean (95%CI)&lt;br&gt;All patients: 95 (100%)&lt;br&gt;TTO: 0.77 (0.73, 0.81)&lt;br&gt;SG: 0.88 (0.84, 0.92)&lt;br&gt;20/20 to 20/25: 15 (15.8%)&lt;br&gt;TTO: 0.85 (0.75, 0.95)&lt;br&gt;SG: 0.90 (0.83, 0.97)&lt;br&gt;20/30 to 20/50: 48 (50.5%)&lt;br&gt;TTO: 0.78 (0.72, 0.84)&lt;br&gt;SG: 0.92 (0.88, 0.96)</td>
<td>20/60 to 20/100: 21 (22.1%)&lt;br&gt;TTO: 0.78 (0.70, 0.86)&lt;br&gt;SG: 0.84 (0.72, 0.96)&lt;br&gt;20/200 to 20/400: 7 (7.4%)&lt;br&gt;TTO: 0.64 (0.53, 0.75)&lt;br&gt;SG: 0.71 (0.58, 0.84)&lt;br&gt;CF to HM: 4 (4.2%)&lt;br&gt;TTO: 0.59 (0.23, 0.95)&lt;br&gt;SG: 0.70 (0.29, 1.11)</td>
</tr>
<tr>
<td>Brown 2002</td>
<td>Diabetic retinopathy</td>
<td>TTO</td>
<td>Visual acuity: n (%)&lt;br&gt;Mean (SD)&lt;br&gt;All patients: 354 (100%)&lt;br&gt;0.79 (0.20)&lt;br&gt;20/20 to 20/25: 72 (20.3%)&lt;br&gt;0.86 (0.17)</td>
<td>20/30 to 20/40: 130 (36.7%)&lt;br&gt;0.80 (0.19)&lt;br&gt;20/50 to 20/100: 95 (26.8%)&lt;br&gt;0.77 (0.18)&lt;br&gt;≤ 20/200: 36 (10.2%)&lt;br&gt;0.60 (0.19)</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>Diabetic retinopathy</td>
<td>SF-12, SF-36</td>
<td>Not reported</td>
<td>SF-12: Mean (SD)&lt;br&gt;PCS: 46 (9)&lt;br&gt;MCS: 51 (9) SF-36: Mean (SD)&lt;br&gt;PCS: 46 (10)&lt;br&gt;MCS: 50 (9)</td>
</tr>
<tr>
<td>Hirai 2012</td>
<td>Diabetic retinopathy</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Baseline SF-36: Mean (SD)&lt;br&gt;PCS: 49.6 (9.6)&lt;br&gt;MCS: 51.6 (8.3) 10-year follow up SF-36: Mean (SD)&lt;br&gt;PCS: 46.2 (11.1)&lt;br&gt;MCS: 52.9 (8.9)</td>
</tr>
<tr>
<td>Sharma 2003</td>
<td>Diabetic retinopathy</td>
<td>TTO</td>
<td>Mean (SD): 0.79 (0.23)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Thomas 2015</td>
<td>Diabetic retinopathy</td>
<td>TTO</td>
<td>Mean (SD): 0.81 (0.33)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**: EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; CF: counting fingers; HM: hand motions; MCS:
mental component score; NLP: no light perception; NPDR: non proliferative diabetic retinopathy; PCS: physical component score

Table 3-3d. Health-related quality of life outcomes in patients with cataracts.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boisjoly 2010</td>
<td>Cataracts</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Cohort: SF-36: Median (IQR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cohort 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PCS: 75 (50, 90)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCS: 76 (64, 88)</td>
</tr>
<tr>
<td>Espindle 2005</td>
<td>Cataracts</td>
<td>SF-12</td>
<td>Not reported</td>
<td>Treatment group: SF-12: Mean (SD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clear IOL: PCS: 46.10 (10.04)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blue Light–Filtering IOL:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PCS: 54.60 (7.97)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeny a 2012</td>
<td>Cataracts</td>
<td>EQ-5D, HUI2, HUI3, SF-6D</td>
<td>Baseline: Mean (SD) EQ-5D: 0.83 (0.17)</td>
<td>One month postoperatively: Mean (SD) EQ-5D: 0.84 (0.16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean (SD) HUI2: 0.79 (0.17)</td>
<td>Mean (SD) HUI2: 0.81 (0.19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean (SD) HUI3: 0.66 (0.27)</td>
<td>Mean (SD) HUI3: 0.72 (0.28)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean (SD) SF-6D: 0.74 (0.12)</td>
<td>Mean (SD) SF-6D: 0.73 (0.12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lim 2021</td>
<td>Cataracts</td>
<td>EQ-5D</td>
<td>Preoperative mean (SD) 0.85 (0.14)</td>
<td>Postoperative mean (SD): 0.88 (0.12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owsley 2007</td>
<td>Cataracts</td>
<td>SF-36</td>
<td>Not reported</td>
<td>Baseline Group: SF-36: Mean (SD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Follow up group: SF-36: Mean (SD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surgery: PCS: 45.9 (14.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCS: 81.2 (16.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No surgery: PCS: 45.9 (15.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCS: 82.1 (11.1)</td>
</tr>
</tbody>
</table>
**EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; IQR: interquartile range; IOL: intraocular lens; MCS: mental component score; PCS: physical component score; SD: standard deviation; a: Groessl et al. was merged with this study.**

### Table 3-3e. Health-related quality of life outcomes in patients with uveitis.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan 2012</td>
<td>Anterior uveitis</td>
<td>EQ-5D 5L</td>
<td>Patient group: Mean (SD) Back pain: 0.72 (0.21) No back pain: 0.82 (0.16)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Naik 2013</td>
<td>Uveitis</td>
<td>SF-36, SF-6D, EQ-5D</td>
<td>Mean (SD): SF-6D: 0.67 (0.11) Mean (SD): EQ-5D: 0.84 (0.13)</td>
<td>SF-36: Mean (SD) PCS: 47.4 (12.2) MCS: 47.6 (12.7)</td>
</tr>
<tr>
<td>The Multicenter Uveitis Steroid Treatment Trial Research Groupb 2015</td>
<td>Intermediate uveitis, pan uveitis</td>
<td>EQ-5D, SF-36</td>
<td>Uveitis type: EQ-5D Median (IQR) Intermediate uveitis: 0.8 (0.8, 1.0) All patients: 0.8 (0.8, 1.0) Pan uveitis: 0.8 (0.8, 1.0)</td>
<td>Uveitis type: SF-36 health survey subscales Median (IQR): PCS: 50 (41, 55) MCS: 52 (43, 57) All patients: Pan uveitis: PCS: 50 (41, 55) MCS: 52 (40, 57) May: 52 (37, 56)</td>
</tr>
</tbody>
</table>

### Table 3-3f. Health-related quality of life outcomes in patients with dry eye disease.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dana 2020</td>
<td>DED</td>
<td>EQ-5D 5L</td>
<td>Mean (SD): 0.82 (0.13)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Farrand 2016</td>
<td>DED</td>
<td>SF-36</td>
<td>Not reported</td>
<td>DED type: Mean (SD) Symptomatic-Undiagnosed DED: Diagnosed-DED: PCS: 48.8 (9.5) MCS: 44.6 (11.6)</td>
</tr>
<tr>
<td>Messmer</td>
<td>DED</td>
<td>EQ-5D 5L</td>
<td>Severity of DED: Moderate: 0.759</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; ETDRS: Early Treatment Diabetic Retinopathy Study; IQR: interquartile range; IOL: intraocular lens; MCS: mental component score; PCS: physical component score; SD: standard deviation; SE: standard error; b: Frick et al. and Sugar et al. were merged with this study.**
### Table 3-3g. Health-related quality of life outcomes in patients with miscellaneous eye diseases.

<table>
<thead>
<tr>
<th>First Author and Year of Publication</th>
<th>Eye disease(s)</th>
<th>Elicitation method**</th>
<th>Utility values</th>
<th>Summary scores on preference-based measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balshaw 2012</td>
<td>CRVO, BRVO</td>
<td>HUI3</td>
<td>Mean (SD): 0.80 (0.42)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Beauchamp 2006</td>
<td>Strabismus</td>
<td>TTO</td>
<td>Mean (SD) preoperative: 0.85 (0.20)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>PVD</td>
<td>SF-12, SF-36</td>
<td>Not reported</td>
<td>SF-12: Mean (SD) PCS: 51 (9)</td>
</tr>
<tr>
<td>Globe 2002</td>
<td>Retinal detachment</td>
<td>SF-12, SF-36</td>
<td>Not reported</td>
<td>SF-12: Mean (SD) PCS: 49 (8)</td>
</tr>
<tr>
<td>Loftus 2011</td>
<td>DME</td>
<td>EQ-5D 3L</td>
<td>Baseline: Mean Pegaptanib: 0.741</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

****: EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; BRVO: branch retinal vein occlusion; CRVO: central retinal vein occlusion; DME: diabetic macular edema; MCS: mental component score; PCS: physical component score; PVD: posterior vitreous detachment; SD: standard deviation.
3.4 Discussion

The current review investigated the HRQoL in patients with a variety of eye diseases including glaucoma, ARMD, DR, cataracts, uveitis, and DED. In doing so, it provides an overview of the values of HRQoL associated with these eye diseases that can be utilized in economic evaluations. In characterizing the GPBM summary scores, it was shown that based on the SF-12, the mean PCS values ranged from 39.2 to 44.67 and the mean MCS values ranged from 48.7 to 52.2. Similarly, based on the SF-36, the mean PCS values ranged from 45.6 to 53.8 and the mean MCS values ranged from 54.2 to 63.1. In patients with ARMD, the mean PCS values ranged from 44.0 to 46.8 and the mean MCS values ranged from 49.8 to 50.9 based on the SF-12. The mean PCS values ranged from 41.0 to 47.0 and the mean MCS values ranged from 38.0 to 52.0 based on the SF-36. Among the studies focusing on DR, the mean PCS value was 46.0 and the mean MCS values ranged from 51.0. Similarly, based on the SF-36, the mean PCS values ranged from 46.2 to 46.0 and the mean MCS values ranged from 50.0 to 52.9. For the studies pertaining to patients with cataracts, the mean PCS values ranged from 43.2 to 46.1 and the mean MCS values ranged from 54.0 to 54.6 based on the SF-12. However, based on the SF-36, the central tendencies of PCS values ranged from 45.9 to 75.0 and the mean MCS values ranged from 76.0 to 82.1. The included studies on patients with uveitis reported PCS and MCS scores with measures of central tendency ranging from 47.4 to 50.0 and 47.6 to 52.0 respectively based on the SF-36. Finally, the studies focused on DED reported mean PCS and MCS values ranging from 45.3 to 48.8 and 44.6 to 51.0 based on the SF-36 as well. Overall, across each eye disease, the measures of central tendency of the scores generally appeared to be near 50. PCS and MCS values can range
between 0 to 100, however a mean (SD) of 50 (10) has been noted to be the PCS and MCS values of the US general population for both the SF-12 and SF-36\textsuperscript{57,58}.

As per the analysis of the utility values of the patients with eye disease, the mean utility values of patients with glaucoma were quite high between 0.89 to 0.94, indicating that the QoL for glaucoma patients appears to be quite good. The mean utility values for collective patients with ARMD were much more variable ranging from 0.74 to 0.81. However, based on studies that reported utility values stratified by disease severity, mean utility values as low as 0.40 and as high as 0.96 were reported among groups of patients with more severe and less severe forms of ARMD respectively. Similarly, the mean utility values of collective patients with DR ranged from 0.77 to 0.88. However, among studies that reported utility values stratified by disease severity, mean utility values as low as 0.59 and as high as 0.92 were reported among groups of patients with more severe and less severe forms of DR respectively. The mean utility scores for patients with cataracts ranged from 0.66 to 0.85. The measures of central tendency for utility values of patients with uveitis ranged from 0.67 to 0.84. Finally, the mean utility values of collective patients living with DED ranged from 0.78 to 0.82. However, among studies that reported utility values stratified by disease severity, mean utility values as low as 0.62 and as high as 0.81 were reported in patients with more severe and less severe forms of DED respectively. Overall, the utility values across patients with ARMD, DR, uveitis, and DED appear to be quite similar while the values in patients with glaucoma appear to be higher.
In previous systematic reviews of QoL in eye diseases, the typical focus is on the relationship between vision impairment and QoL values\(^9,11,59,60\). Of note, a recent systematic review by Assi et al.\(^{10}\) was an umbrella systematic review that examined the association between vision impairment or specific eye diseases and reduced QoL and the effectiveness that ophthalmic interventions can have on improving QoL. However, it did not focus on the HRQoL values from direct preference elicitation methods or GPBM.

Among systematic reviews of QoL in patients with eye diseases, is a systematic review by Evans et al.\(^{12}\). In that review, the authors captured studies pertaining to the QoL of diseases impairing peripheral and central vision including glaucoma, ARMD, and cataracts. Evans et al.\(^{12}\) noted that in most QoL domains of the SF-36 and SF-12 the difference between the impact of the two diseases was slight and unlikely to be clinically significant. This finding appears to concur with the results of this systematic review since the range of PCS and MCS scores across the different eye diseases were relatively similar. Moreover, using weighted means, the authors found that ARMD had a greater impact on the physical components than mental components of the SF-36 and SF-12. This finding appears to contrast with the results of the current study. Additionally, Evans et al\(^{12}\) noted that patients with glaucoma exhibited a similar degree of QoL impairment to those with cataracts using EQ-5D. This finding does appear to agree with the results of this systematic review that demonstrated an EQ-5D score of 0.89 in the study on glaucoma patients and EQ-5D scores from 0.83 to 0.85 reported for patients with cataracts. However, it should be noted that Evans et al.\(^{12}\) included studies from countries
not restricted to North America that were published before July 13, 2007. Furthermore, the characteristics of their included studies and study participants were unclear.

Another similar systematic review by Poku et al.\textsuperscript{11} on DR and ARMD focused on the relationship between utility values and visual impairment. In their study, it was noted that the mean utility of patients with DR overall was 0.79 across their included studies. Furthermore, it was noted that the mean utility of patients with ARMD overall was 0.81\textsuperscript{11}. While the authors did not limit their included studies to a particular geographical region, both of their results are similar to the findings of the current systematic review.

While this study provides valuable information on the HRQoL values assigned to a variety of different eye diseases, this study is limited by the literature included. Five of the 39 included studies were deemed to be of a high RoB upon assessment\textsuperscript{17,22,30,34,42}. These 5 studies imply low confidence that they present valid HRQoL values for their respective diseases. However, the other 34 included studies were of moderate or low RoB. As such, the majority of the included studies appear to be providing valid HRQoL implying confidence in the results of the current review. Nonetheless, regardless of their quality, all studies were included for analysis. Furthermore, this review captured studies that were performed in North American countries. As such, these values may not represent HRQoL values in other countries. Additionally, to systematically gather a consistent data on HRQoL, a location restriction was placed. This restriction also resulted in the exclusion of 92 other articles that measured HRQoL among other eye conditions including but not limited to ocular toxoplasmosis, endophthalmitis, anophthalmus, or macular holes. However, the key objective of this systematic review was to measure
HRQoL in patients with various eye diseases in the North American continent. Additionally, this review is also restricted to an adult patient group. As a result, this review does not incorporate sufficient information on eye diseases that are much more common in pediatric patient populations such as amblyopia and strabismus\textsuperscript{34,61}. A future study could incorporate a bigger variety of studies not restricted to North America to provide a more comprehensive summary on HRQoL of eye diseases from a more global perspective. Furthermore, a future study could also focus more on eye diseases that affect the pediatric population.

3.5 Conclusions

This systematic review has shown that HRQoL across patients with glaucoma, ARMD, diabetic retinopathy, cataracts, uveitis, and DED was similar using the SF-12 and SF-36. Furthermore, their summary scores appear to suggest normal HRQoL. This systematic review has also shown that the utility values across patients with ARMD, DR, uveitis, and DED appear to be similar, while the values in patients with glaucoma appear to be higher. However, further studies need to be done to better understand the QoL for patients with other visual conditions among different populations.

3.6 References


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Chapter 4 Quality of Life of Seniors with Eye Diseases During COVID-19

4 Abstract

**Background:** The ophthalmology clientele is vulnerable to psychological stressors in the context of the coronavirus disease 2019 (COVID-19) pandemic.

**Objective:** To assess health-related quality of life (HRQoL), vision-related quality of life (VRQoL), depression and anxiety symptoms, and social support and community integration of seniors with eye diseases. To identify important predictor variables of the outcomes above.

**Methods:** A cross-sectional survey study was conducted among seniors with eye diseases (n=90). Linear regression analysis with backward stepwise selection was used to predict the value of the outcomes of eye disease. Through leave-one-out cross-validation, the predictive performance of each model was assessed with root mean squared error and mean absolute error. Further, model assumptions for each backwards stepwise regression model were tested.

**Results:** Based on the analysis, preference-based HRQoL of the study patients with eye diseases during the pandemic is likely good with a mean utility value of 0.88. VRQoL and sleep quality appeared to be good as well. Depression and anxiety symptoms appeared to be low, while community integration and social support were moderate. Furthermore, the presence of retinal disease, number of non-ocular comorbidities, and
education appeared to have significant negative effects on social support and community integration. The presence of retinal disease and the number of non-ocular comorbidities both appeared to negatively impact VRQoL. The use of a mobility aid appeared to negatively affect depressive symptoms and sleep quality.

Conclusions: The overall quality of life and wellness among seniors with eye diseases appeared to be good during the COVID-19 pandemic. However, the presence of retinal disease and the number of non-ocular comorbidities both appeared to negatively impact VRQoL and social support and community integration. Education appeared to impact social support and community integration negatively. The use of a mobility aid appeared to negatively affect depressive symptoms and sleep quality.

4.1 Introduction

Coronavirus disease 2019 (COVID-19) is a highly infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)\textsuperscript{1}. This disease has been reported to be able to cause severe acute respiratory infection with an incubation period of 1–14 days\textsuperscript{2}. Many of the common symptoms of COVID-19 include fever, dry cough, as well as fatigue\textsuperscript{3}. The SARS-CoV-2 virus has been reported to be transmitted via respiratory droplets; however, it can also be spread through various discharges, feces, aerosol, and conjunctiva\textsuperscript{4}.

The first reported outbreak occurred in Wuhan, China in 2019. At the beginning of 2020 February, it was reported by the National Health Commission of the People’s Republic of China that 3,387 healthcare workers have confirmed COVID-19 infections.
However, even before February 2020, COVID-19 had already made its way to Canada in Ontario; in late January 2020, the first imported case of COVID-19 was reported. Following this case, community transmission was then documented within British Colombia on March 1, 2020. As the virus continued to spread throughout Canada and the rest of the globe, on March 11 of 2020, the World Health Organization (WHO) decided to declare the COVID-19 outbreak a pandemic. Later, in April of 2020, over 2,000,000 people from 210 countries were reported to have been infected with the death toll being over 140,000 people worldwide.

The burden brought on by the COVID-19 pandemic has affected many groups of individuals on a global level. One vulnerable group of individuals who have been greatly impacted by the pandemic are patients with ophthalmological conditions. Patients in this group are particularly vulnerable in the context of the COVID-19 pandemic because of their age and pre-existing comorbid conditions; specifically, elderly patients aged 65 and above with eye diseases like glaucoma, age-related macular degeneration, or diabetic retinopathy require regular follow-ups and commonly suffer from additional comorbidities. These additional conditions include anxiety and depression which have been shown to be exacerbated throughout the ongoing pandemic. Even if these individuals do not currently have such comorbidities, they are extremely susceptible to developing mental health issues.

Further, the negative impact of the COVID-19 pandemic has been shown to be pronounced among elderly individuals through public media outlets portraying COVID-19 as a disease that is particularly devastating to the elderly. This spread of
misinformation, in turn, has resulted in the development of social stigma and discrimination causing additional distress to elderly individuals, their families, and their caregivers. Moreover, because of their age, elderly individuals are at a high risk of mortality upon being infected by COVID-19. This information compounds their worry about being infected with the virus and not having access to proper healthcare. In addition to the vulnerabilities imposed by their age group, because of the proximity between the patient and health care personnel during ophthalmological examinations, the risk of transmission can be perceived as being relatively high among seniors with ophthalmologic conditions. As such, the delicate balance between the risk of exposure to COVID-19 and visual loss in delaying cases is a psychological stressor to both patients and clinicians.

The present pandemic has led officials to rethink the management of patient lists and to restrict the patients to be assessed or treated based on the urgency of their condition in accordance with ministerial guidelines. These restrictions may have potentially resulted in many delays in clinical visits which, in turn, may increase the risk of visual loss not only by delaying necessary care but also by making patients less likely to follow their physician’s guidance for their conditions. Moreover, due to the inability to attend clinical visits, patients themselves might decide to become nonadherent and interrupt their treatment or postpone their visit for fear of contracting SARS-CoV-2. Furthermore, the COVID-19 pandemic conditions have created even more difficulty to access medications that are high in demand and have made it difficult to make changes to treatments when necessary. Additionally, visual loss can accompany depressive
symptoms and deteriorate the quality of life (QoL)\textsuperscript{15} in addition to the difficulties already present due to their ocular diseases and potential comorbidities. Thus, it is necessary to characterize and document the quality of life and mental well-being of patients with various ophthalmologic conditions during the COVID-19 pandemic.

In documenting the QoL and wellness of patients during the COVID-19 pandemic, we can quantify the collateral impact of COVID-19 beyond the direct impact of the virus. Furthermore, this will help to improve the future quality of care during non-COVID-19 conditions and even during potential future pandemic situations. Therefore, the goal of this study is to characterize the preference-based health-related quality of life (HRQoL), vision-related QoL (VRQoL), depression and anxiety symptoms, sleep quality, and social support and community integration of seniors aged 65 and above with various eye diseases during the COVID-19 pandemic. Furthermore, this study also aims to identify important predictor variables for the aforementioned measures.

4.2 Methods

4.2.1 Study design and Sampling Procedures

The study followed a cross-sectional design. A convenience sample of 90 patients who were identified as having an underlying ocular disease were recruited from four ophthalmic practices at the Ivey Eye Institute, St. Joseph’s Health Care London, Ontario. The clinical protocol was conducted in accordance with the Western Research Ethics Manager (WREM) at the University of Western Ontario. All patients were sequentially recruited from November 2021 to May 2022 using convenience sampling. The eligibility
of the patients who were attending their regular ophthalmology visits was determined by the ophthalmologist on staff. Inclusion criteria included patients who were age 65 and above and diagnosed with an eye disease by an experienced ophthalmologist. Exclusion criteria included patients who were unable to provide valid informed consent, who had significant communication barriers or lack of English proficiency that prevents participants from completing the questionnaires, or who had irreversible vision loss that prevented them from completing the questionnaires.

All participants received a complete explanation of the purpose and procedures involved in the study and patient concerns were addressed prior to study participation. Both verbal and electronically written informed consent were obtained from all participating patients. The study was initiated after approval by WREM (refer to Appendix A for the approval letter) and Lawson Health Research Institute’s Clinical Research Impact Committee.

4.2.2 Data Collection

All data were collected through electronic questionnaires accompanied by face-to-face interviews for assistance. All data were recorded electronically using the UWO Qualtrics questionnaires that were set up in advance. Data from Qualtrics were then imported to a password-protected and encrypted spreadsheet on the password-protected local computer in the principal investigator’s (M.M) office at St. Joseph’s Healthcare. Data were coded to protect participant confidentiality. The code key with identifying data (Master data) was also stored in a password-protected and encrypted spreadsheet on the
password-protected local computer in the principal investigator’s office. For analysis purposes, the de-identified study data not containing patient information was stored in a password-protected and encrypted spreadsheet on the St. Joseph’s Hospital OneDrive. Data quality checks were performed at random.

Following clinical examination of the patients, the ophthalmologists at the Ivey Eye Institute identified and referred participants to the research assistant on duty based on the inclusion and exclusion criteria. The questionnaires were presented to the patients using a combination of self-administered and interviewer-assisted modes. Participants provided informed consent and completed the 30-minute questionnaire. The questionnaire included the Time Trade-Off (TTO) questionnaire, the 25-item version National Eye Institute Visual Function Questionnaire (NEI VFQ-25), Hospital Anxiety and Depression Scale – Anxiety subscale (HADS-A), Center for Epidemiologic Studies – Depression scale (CES-D), Pittsburgh Sleep Quality Index (PSQI), and Community Integration Questionnaire (CIQ). Demographic characteristics on patients’ age, socioeconomic status (SES), ethnicity, education level, living arrangement, city of residence, and use of mobility aid were also collected. All of which were provided by patients themselves in the electronic questionnaires.

The TTO was used to obtain utility scores to calculate patients’ preference-based HRQOL. Preference-based HRQOL is a frequently used measure calculated with utility values on a scale from 0 to 1, where 0 represents a health state equal to death and 1 represents a state of perfect health\textsuperscript{16}. In the current study, the utility score using the TTO method was calculated by dividing the number of years a patient was willing to trade in
return for perfect vision by the estimated number of years of life remaining and subtracting this number from 1.

VRQOL measures the impact of vision on an individual’s daily living, as well as one’s satisfaction and attitudes towards their vision. The NEI VFQ-25 is divided into 12 subscales: general health, general vision, near vision, distance vision, driving, peripheral vision, color vision, ocular pain, role limitations, dependency, social function, and mental health. The NEI VFQ-25 was also shown to have high validity and reliability\(^1\). The HADS-A is a 7-item self-report subscale for measuring symptoms of anxiety. Each item on the questionnaire is scored from 0 to 3, with total scores ranging from 0 to 21. Higher scores represent higher levels of psychological distress\(^1\). The HADS-A has been used in a previous study on the impact of low vision on the QoL, depression, anxiety, and social support\(^1\). A score ≥ 8 on the HADS-A has a sensitivity of 0.9 and specificity of 0.79 for identifying patients with anxiety\(^2\). The HADS-A has been demonstrated to have adequate internal consistency with a Cronbach’s alpha value of 0.87 when administered in older adults\(^3\).

The CES-D is a brief self-report scale designed to measure self-reported symptoms associated with depression experienced in the past week. The CES-D includes twenty items comprising six scales reflecting major facets of depression. The possible range of CES-D scores is 0 to 60, with the higher scores indicating the presence of more depressive symptomatology. A CES-D score ≥ 16 has high sensitivity and specificity rates for identifying subjects with depressive disorder. The CES-D has been demonstrated
to be reliable with coefficient alpha estimates of 0.90 in clinical older adults. It has also been demonstrated to have high construct validity when administered to older adults\textsuperscript{22}.

The PSQI is a self-report questionnaire that assesses sleep quality over a 1-month time interval. The measure consists of 19 individual items, creating 7 components that produce one global score\textsuperscript{23}. Higher PSQI scores indicate worse sleep quality. A PSQI score > 5 has sensitivity and specificity rates of 89.6\% and 86.5\%, respectively, for identifying cases with sleep disorder\textsuperscript{24}. The PSQI has been shown to have a high test-retest reliability and a good validity\textsuperscript{25}.

The CIQ is a 15-item inventory designed to measure levels of community integration. The overall score ranges from 0 to 29, and can be further divided into three sub-scores, corresponding to integration in the home, social integration, and productivity. A higher CIQ score represents greater integration\textsuperscript{26}. Previous research has demonstrated adequate test-retest reliability and internal consistency\textsuperscript{27}.

All patients were interviewed under standardized conditions. The interviews were conducted by four interviewers who all received standardized training prior to administering the questionnaires. All questionnaires were completed by the patient in an electronic format on an electronic tablet through the UWO Qualtrics link containing the questionnaires. While completing the questionnaires, a research assistant was present to assist by answering any questions or concerns about the questionnaires, if patients had any, as well as to administer the questionnaires.
4.2.3 Statistical analysis

All statistical analyses were performed using STATA 17.0. The descriptive statistics were computed for all demographic variables while univariate analysis was computed for all questionnaire outcome measures. To understand the central tendency and distribution of continuous variables, means, and standard deviations were calculated.

Associations between predictor variables were also assessed using Pearson correlations between continuous predictor variables, The Pearson correlation coefficient threshold absolute value of 0.6 was used as a cut-off indicating a strong association between the variables\textsuperscript{28}. If a threshold above 0.6 was identified, then a significance test was conducted to confirm the association. Chi-square tests were used to assess the association between pairs of categorical predictor variables. The significance of the relationship between the predictor variables was defined at p<0.050. T-tests and one-way ANOVA were used to assess the associations between pairs of continuous and categorical predictor variables. Again, statistical significance was determined at p<0.050.

Bivariate analysis was performed to assess the unadjusted effect estimates and check whether each predictor variable and outcome were associated. Each of the predictor variables (age, number of non-ocular comorbidities, number of ocular comorbidities, use of a mobility aid, SES during COVID-19, living arrangements, education, presence of retinal disease, presence of glaucoma, and presence of cataracts) was individually investigated for association with all six outcomes, using simple linear regression analyses.

Linear regression models were also created with the questionnaire scores as the dependent variables using backwards stepwise multiple regression. In backwards stepwise
regression, all predictor variables are first used in the model. Following this, tests are then performed to determine the least significant predictor variable that is to be removed. Predictor variables continue to be removed until all remaining predictors are determined to be relevant predictors of the outcome in the model. Regression coefficients were deemed to be significant if the associated p-values were <0.050.

To assess the backwards stepwise linear regression models’ ability to accurately predict each outcome, leave-one-out cross-validation (LOOCV) of each model. In LOOCV, a single observation is used for the testing set while n-1 observations are used for the training set\(^29\). This process is repeated until each observation has been a part of the testing set. LOOCV evaluates a model based on prediction and is used for estimating the test error. The root mean squared error (RMSE) and mean absolute error (MAE) were determined for each multivariable model.

Further, model assumptions for each multivariable model were tested. Namely, the constant variance of the residuals was tested using residuals versus fitted values plots. The normality of the residuals was assessed using quantile-quantile (Q-Q) plots. Linearity between the predictors and outcomes was assessed using component-plus-residual plots. The variance inflation factor (VIF) was used to test for multicollinearity. A VIF of 10 was used as the rule of thumb to indicate an acceptable level of multicollinearity\(^30\).

We believed the missing data were missing at random conditioned on the other variables (i.e., education). Then non-response rate was 0.06% (n=5), 0% (n=0), 0% (n=0), 0.02% (n=2), 0% (n=0), and 0.02% (n=2) for the TTO, NEI VFQ-25, CES-D, HADS-A,
PSQI, and CIQ, respectively. Considering the nonresponse rate was small, these individuals were excluded from all relevant analyses.

4.3 Results

4.3.1 Participants and Participant Characteristics

A total of 128 patients were approached by the attending clinicians and asked to participate in the study. Of the 128 patients, 115 agreed to participate, however, 25 of these patients did not pass the inclusion/exclusion criteria. As such, a total of 90 participants consented and were included in the study. To summarize the characteristics of these included participants, univariate analyses were conducted. The participants’ characteristics can be seen in Table 4-1. The mean age of the participants was 77.8 years with a standard deviation of 8.0 years. In terms of the ethnicities of the participants, 86 identified as being white, two participants identified as being Black, one participant identified as being Arab, and one participant did not indicate his or her ethnicity. Of the included participants, 37 participants completed high school or less and 53 participants had additional training or higher education. It was also noted that 23 participants had an income of $25,000 or less. Moreover, 67 participants lived at home with their family, spouse, or caregiver, while 22 participants lived at home alone and only one participant lived in a nursing home. Finally, 15 participants reported using a mobility aid such as a cane, walker, wheelchair, or motorized scooter.

The participants’ clinical characteristics can be seen in Table 4-2. Of the 90 total participants, the mean number of non-ocular comorbidities was 1.6 with a standard
deviation of 1.7. Of the 77 participants who reported their eye disease(s), the mean number of ocular comorbidities was 1.2 with a standard deviation of 0.5. In terms of the eye diseases with which participants presented, 22 participants had only retinal disease, 31 participants had only glaucoma, 8 participants had only cataracts, 1 participant had only dry eye disease (DED), 1 participant had only uveitis, and 1 participant had only asteroid hyalosis. However, 3 participants had both retinal disease and glaucoma, 5 participants had both retinal disease and cataracts, and 4 participants had glaucoma and cataracts.

4.3.2 Associations between predictor variables

4.3.2.1 Association between continuous predictor variables

The results of the associations between continuous predictor variables are presented in Appendix L. Pearson correlations did not reveal any strong linear associations between the continuous predictor variables: age, number of non-ocular comorbidities, and number of ocular comorbidities.

4.3.2.2 Association between pairs of categorical predictor variables

The chi-square test results of the associations between categorical predictor variables are also presented in Appendix L. Significant associations were observed between the presence of retinal disease and glaucoma. Among patients who had a retinal disease, 90% did not also have glaucoma. Significant associations were also observed between the presence of glaucoma and cataracts. Among patients with glaucoma, 90% did not also have cataracts.
4.3.2.3 Association Between Pairs of Continuous Predictor Variables

Finally, the t-test and one-way ANOVA results for the associations between continuous and categorical predictor variables are also presented in Appendix L. The use of a mobility aid was significantly associated with age, the number of non-ocular comorbidities, and the number of ocular comorbidities. On average, patients who used a mobility aid were older, had more non-ocular comorbidities, and had more ocular comorbidities. The presence of retinal disease was significantly associated with age. Patients who had retinal disease appeared to be older, on average. The presence of glaucoma was also significantly associated with age, however, it appeared that on average patients without glaucoma were older. Finally, the presence of cataracts was significantly associated with the number of non-ocular comorbidities. On average, patients with cataracts appeared to have a greater number of non-ocular comorbidities.

4.3.3 Preference-based HRQoL

The TTO utility score measures the preference-based quality of life on a scale from 0 to 1, in which a score of 0 represents a state of death and 1 represents perfect visual health. In our study population (n=90), the average TTO utility score was 0.88 with a standard deviation of 0.23 (Table 4-3). Thus, the majority of the patients were willing to trade 12% of their remaining life for perfect vision.

The bivariate analyses for preference-based HRQoL with the demographic and clinical variables is presented in Table 4-4. No variables were significantly associated with preference-based HRQoL.
On average, patients who have completed more than high school in their education have an average difference in their TTO score of 0.05 (95% CI: -0.05, 0.15) as compared to patients who have completed high school or less. The use of a mobility aid, on average, increases the TTO score by 0.02 (95% CI: -0.11, 0.16). For each increase in the number of ocular comorbidities, the TTO score increases by 0.07 (95% CI: -0.06, 0.19). On average, the presence of glaucoma increases the TTO score by 0.04 (95% CI: -0.08, 0.15). The presence of retinal disease changes the TTO score by -0.06 (95% CI: -0.17, 0.05). The presence of cataracts changes the TTO score by -0.09 (95% CI: -0.22, 0.05).

Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have TTO scores with a difference of -0.12 (95% CI: -0.40, 0.16), -0.17 (95% CI: -0.45, 0.11), -0.06 (95% CI: -0.35, 0.22), 0.01 (95% CI: -0.31, 0.32), -0.10 (95% CI: -0.44, 0.23), and -0.33 (95% CI: -0.70, 0.04) respectively as compared to patients with a SES of less than $10,000.

The backwards stepwise regression did not produce a model with any variable predictive of the TTO utility score. This is similar to the results of the bivariate analysis in that no variable was found to be significantly associated with the TTO score.

4.3.4 VRQoL

The NEI VFQ-25 score measures vision-related quality of life on a total scale from 0 to 100, in which a score of 0 represents the worst possible score and 100
represents the best. In our study population (n=90), the average NEI VFQ-25 score was 84.71 with a standard deviation of 11.61 (Table 4-3).

The bivariate analyses for the VRQoL with the demographic and clinical variables is presented in Table 4-5. The following variables were significantly associated with VRQoL: education (p=0.027), number of ocular comorbidities (p=0.042), and the presence of retinal disease. Patients who have completed more than high school in their education have an average difference in their NEI VFQ-25 score of 5.46 (95% CI: 0.62, 10.29) as compared to patients who have completed high school or less. For each increase in the number of ocular comorbidities, the NEI VFQ-25 score changes by -6.31 (95% CI: -12.23, -0.24) The presence of retinal disease changes the NEI VFQ-25 score by -7.56 (95% CI: -12.58, -2.55).

On average, for every year increase in age, the NEI VFQ-25 score changes by -0.28 (95% CI: -0.58, 0.03). Patients living at home with others are expected to have a NEI VFQ-25 score difference of 3.87 (95% CI: -1.68, 9.42) as compared to patients living alone or in a nursing/retirement home. Use of a mobility aid, on average, changes the NEI VFQ-25 score by -6.31 (95% CI: -12.83, 0.21). On average, for each increase in the number of non-ocular comorbidities, the NEI VFQ-25 score changes by -1.23 (95% CI: -2.64, 0.17). On average, the presence of glaucoma increases the NEI VFQ-25 score by 2.88 (95% CI: -2.44, 8.19). The presence of cataracts increases the NEI VFQ-25 score by 1.22 (95% CI: -5.26, 7.69).

Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have
NEI VFQ-25 scores with a difference of -6.54 (95% CI: -20.58, 7.49), -4.63 (95% CI: -18.52, 9.24), -0.29 (95% CI: -14.38, 13.79), 5.53 (95% CI: -10.11, -21.17), 3.57 (95% CI: -12.46, 19.56), and -0.50 (95% CI: -17.81, 16.81) respectively as compared to patients with a SES of less than $10,000.

Upon assessment of the backwards stepwise multivariable linear regression model, the component-plus-residual plot and Q-Q plot did not confirm the assumption of linearity and normality, respectively. However, the residual versus fitted values plot and VIFs confirmed the assumption of homoscedasticity and multicollinearity, respectively (Appendix M). The backwards stepwise multivariable regression model revealed that the presence of retinal disease and number of non-ocular comorbidities were predictive of NEI VFQ-25 score (Table 4-10). Adjusting for the number of non-ocular comorbidities, on average, the presence of retinal disease significantly (p=0.002) changed the NEI VFQ-25 score by -7.92 (95% CI: -12.81, -3.05). For each increase in the number of non-ocular comorbidities, the NEI VFQ-25 score significantly (p=0.033) changes by -1.66 (95% CI: -3.01, -0.31).

4.3.5 Presence of depressive symptoms

The CES-D score measures self-reported symptoms associated with depression experienced in the past week on a scale from 0 to 60, in which higher scores indicate the presence of more depressive symptomatology. In our study population (n=90), the average CES-D score was 6.79 with a standard deviation of 6.39 (Table 4-3).
The bivariate analyses for the presence of depressive symptoms with the demographic and clinical variables is presented in Table 4-6. The following variable was significantly associated with the presence of depressive symptoms. Use of a mobility aid, on average, increases the CES-D score by 4.35 (95% CI: 0.85, 7.86).

On average, patients who have completed more than high school in their education have an average difference in their CES-D score of 1.98 (95% CI: -0.72, 4.69) as compared to patients who have completed high school or less. Patients living at home with others are expected to have a CES-D score difference of -0.05 (95% CI: -3.13, 3.03) as compared to patients living alone or in a nursing/retirement home. For each increase in the number of ocular comorbidities, the CES-D score increases by 2.10 (95% CI: -1.33, 5.53). On average, the presence of glaucoma changes the CES-D score by -1.99 (95% CI: -4.95, 0.98). The presence of retinal disease increases the CES-D score by 2.74 (95% CI: -0.18, 5.67). The presence of cataracts changes the CES-D score by -0.43 (95% CI: -4.06, 3.20).

Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have CES-D scores with a difference of -4.42 (95% CI: -12.61, 3.77), -3.13 (95% CI: -11.23, 4.98), -4.51 (95% CI: -12.73, 3.71), -1.24 (95% CI: -10.37, -7.89), -8.00 (95% CI: -17.35, 1.35), and -3.42 (95% CI: -13.52, 6.69) respectively as compared to patients with a SES of less than $10,000.

Upon assessment of the backwards stepwise multivariable linear regression model, Q-Q plot did not confirm the assumption of normality. However, the residual-
versus-fitted values plot and the VIFs confirmed the assumption of homoscedasticity and multicollinearity, respectively (Appendix M). The backwards stepwise multivariable regression model revealed that the presence of retinal disease and the use of a mobility aid were predictive of CES-D score (Table 4-10). On average, adjusting for the use of a mobility aid, the presence of retinal disease increased the CES-D score by 2.50 (95% CI: -0.43, 5.43), however, this increase was not significant (p=0.094). Adjusting for the presence of retinal disease, the use of a mobility aid significantly (p=0.028) increased the CES-D score by 4.20 (95% CI: 0.46, 7.94).

4.3.6 Presence of anxiety symptoms

The HADS-A subscale measures symptoms of anxiety in the past week each using a scale from 0 to 21 in which higher scores represent higher levels of anxiety. In our study population (n=88), the average HADS-A score was 2.83 with a standard deviation of 2.56 (Table 4-3).

The bivariate analyses for the presence of anxiety symptoms with the demographic and clinical variables is presented in Table 4-7. No variables were significantly associated with the presence of anxiety symptoms.

On average, patients living at home with others are expected to have a HADS-A score difference of 0.71 (95% CI: -0.52, 1.94) as compared to patients living alone or in a nursing/retirement home. Use of a mobility aid, on average, increases the HADS-A score by 0.58 (95% CI: -0.87, 2.04). On average, for each increase in the number of non-ocular comorbidities, the HADS-A score increases by 0.11 (95% CI: -0.21, 0.42). For each
increase in the number of ocular comorbidities, the HADS-A score increases by 0.53 (95% CI: -0.83, 1.89). On average, the presence of glaucoma changes the HADS-A score by -0.12 (95% CI: -1.32, 1.07). The presence of retinal disease increases the HADS-A score by 0.84 (95% CI: -0.33, 2.02). The presence of cataracts changes the HADS-A score by -0.71 (95% CI: -2.15, 0.73).

Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have HADS-A scores with a difference of -0.05 (95% CI: -3.30, 3.20), 0.21 (95% CI: -3.00, 3.42), 0.37 (95% CI: -2.89, 3.63), -1.43 (95% CI: -5.05, -2.19), -0.83 (95% CI: -4.54, 2.87), and -1.50 (95% CI: -5.51, 2.51) respectively as compared to patients with a SES of less than $10,000.

Upon assessment of the backwards stepwise linear regression model, the Q-Q plot did not confirm the assumption of normality, but the residual-versus-fitted values plot confirmed the assumption of homoscedasticity (Appendix M). The backwards stepwise regression model revealed that the use of a mobility aid was the only variable predictive of HADS-A score (Table 4-10). Once again, this model displays that, on average, the use of a mobility aid increases the HADS-A score by 0.58 (95% CI: -0.87, 2.04), however, this change is not significant (p=0.428).

### 4.3.7 Sleep Quality

The PSQI score measures sleep quality over a 1-month time interval on a global scale from 0 to 21, in which higher scores indicate worse sleep quality. In our study
population (n=90), the average PSQI score was 6.58 with a standard deviation of 3.00 (Table 4-3).

The bivariate analyses for sleep quality with the demographic and clinical variables is presented in Table 4-8. The following variables were significantly associated with sleep quality: use of a mobility aid (p=0.044), and SES during COVID-19. Use of a mobility aid, on average, increases the PSQI score by 1.73 (95% CI: 0.05, 3.41). Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have PSQI scores with a difference of -3.26 (95% CI: -7.00, 0.48), -3.26 (95% CI: -6.95, 0.43), -3.47 (95% CI: -7.21, 0.26), -4.43 (95% CI: -8.58, -0.28), -4.67 (95% CI: -8.92, -0.41), and -2.50 (95% CI: -7.10, 2.10) respectively as compared to patients with a SES of less than $10,000.

On average, for every year increase in age, the PSQI score changes by -0.01 (95% CI: -0.09, 0.08). Patients who have completed more than high school in their education have an average difference in their PSQI score of 0.82 (95% CI: -0.48, 2.11) as compared to patients who have completed high school or less. Patients living at home with others are expected to have a PSQI score difference of -1.17 (95% CI: -2.62, 0.29) as compared to patients living alone or in a nursing/retirement home. On average, for each increase in the number of non-ocular comorbidities, the PSQI score increases by 0.22 (95% CI: -0.15, 0.59). For each increase in the number of ocular comorbidities, the PSQI score increases by 0.36 (95% CI: -1.18, 1.90). On average, the presence of glaucoma changes the PSQI score by -0.56 (95% CI: -1.94, 0.81). The presence of retinal disease increases
the PSQI score by 0.57 (95% CI: -0.82, 1.95). Finally, the presence of cataracts changes the PSQI score by -0.28 (95% CI: -1.97, 1.42).

Upon assessment of the backwards stepwise linear regression model, the Q-Q plot did not confirm the assumption of normality, but the residual-versus-fitted values plot confirmed the assumption of homoscedasticity (Appendix M). The backwards stepwise regression model revealed that the use of a mobility aid was the only variable predictive of PSQI score (Table 4-10). Once again, this model displays that, on average, the use of a mobility aid significantly (p=0.044) increases the PSQI score by 1.73 (95% CI: 0.05, 3.41).

4.3.8 Social Support and Community Integration

The CIQ score measures social support and community integration on a scale from 0 to 29, in which a higher score represents more complete community integration and a higher level of social support. In our study population (n=88), the average CIQ total score was 14.46 with a standard deviation of 4.07 (Table 4-3).

The bivariate analyses for social support and community integration with the demographic and clinical variables is presented in Table 4-9. The following variables were significantly associated with social support and community integration: number of non-ocular comorbidities (p=0.047), and presence of retinal disease (p=0.001). On average, for each increase in the number of non-ocular comorbidities, the CIQ score changes by -0.50 (95% CI: -1.00, -0.01). The presence of retinal disease changes the CIQ score by -3.06 (95% CI: -4.82, -1.30).
On average, for every year increase in age, the CIQ score changes by -0.10 (95% CI: -0.21, 0.02). Patients who have completed more than high school in their education have an average difference in their CIQ score of -1.23 (95% CI: -2.98, 0.53) as compared to patients who have completed high school or less. Patients living at home with others are expected to have a CIQ score difference of -0.67 (95% CI: -2.67, 1.33) as compared to patients living alone or in a nursing/retirement home. Use of a mobility aid, on average, changes the CIQ score by -1.22 (95% CI: -3.54, -1.10). The presence of glaucoma increases the CIQ score by 0.80 (95% CI: -1.14, 2.73). The presence of cataracts changes the CIQ score by -0.07 (95% CI: -2.45, 2.31). On average, for each increase in the number of ocular comorbidities, the CIQ score changes by -1.51 (95% CI: -3.70, 0.68).

Patients with a SES of $10,001 - $25,000, $25,001 - $50,000, $50,001 - $75,000, $75,001 - $100,000, $100,001 - $125,000, and greater than $150,000 are expected to have CIQ scores with a difference of -0.02 (95% CI: -5.30, 5.25), 0.33 (95% CI: -4.88, -5.54), 0.13 (95% CI: -5.15, 5.40), 3.38 (95% CI: -2.48, 9.24), 0.92 (95% CI: -5.09, 6.92), and 1.67 (95% CI: -4.82, 8.15) respectively as compared to patients with a SES of less than $10,000.

Upon assessment of the backwards stepwise multivariable linear regression model, the component-plus-residual plot, Q-Q plot, residual-versus-fitted values plot and the VIFs confirmed the assumption of linearity, normality, homoscedasticity, and multicollinearity, respectively (Appendix M). The backwards stepwise multivariable regression model revealed that the presence of retinal disease, number of non-ocular comorbidities, and education were predictive of CIQ score (Table 4-10). Adjusting for all
other predictors, on average, the presence of retinal disease significantly \( (p<0.001) \) changed the CIQ score by -3.10 \( (95\% \text{ CI: } -4.77, -1.43) \). For each increase in the number of non-ocular comorbidities, the CIQ score significantly \( (p=0.004) \) changes by -0.68 \( (95\% \text{ CI: } -1.15, -0.22) \). Finally, having education of more than high school significantly \( (p=0.033) \) changes the CIQ score on average by -1.79 \( (95\% \text{ CI: } -3.44, -0.15) \).

### 4.3.9 Results of the LOOCV

The results of LOOCV assessment of the models in Appendix N demonstrate that the backwards stepwise regression models for VRQoL, and social support and community integration had generally similar MAEs as compared to a similar previous study by Uruthiramoorthy et al\(^{36}\). The MAE of the VRQoL model in the current study is slightly higher than the models in the previous study suggesting that the model in the current study could be nearly as predictive as the previous models. However, the multivariable model for social support and community integration in the current study had an even lower value of MAE as compared to the study by Uruthiramoorthy et al\(^{36}\) indicating that it may be more predictive of the outcome.

### Table 4-1. Demographic characteristics of the included participants.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Full Sample (N=90)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>77.8 (8.0)</td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>86/90 (96%)</td>
</tr>
<tr>
<td>Black</td>
<td>2/90 (2%)</td>
</tr>
<tr>
<td>Arab</td>
<td>1/90 (1%)</td>
</tr>
<tr>
<td>Choice not listed</td>
<td>1/90 (1%)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
</tr>
<tr>
<td>Some high school or less</td>
<td>8/90 (9%)</td>
</tr>
<tr>
<td>Completed high school</td>
<td>29/90 (32%)</td>
</tr>
</tbody>
</table>
Table 4-2. Clinical characteristics of the included participants.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Full Sample (N=90)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye diseases, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>None reported</td>
<td>13/90 (18%)</td>
</tr>
<tr>
<td>Retinal only</td>
<td>22/90 (21%)</td>
</tr>
<tr>
<td>Glaucoma only</td>
<td>31/90 (34%)</td>
</tr>
<tr>
<td>Cataracts only</td>
<td>8/90 (9%)</td>
</tr>
<tr>
<td>Dry eye only</td>
<td>1/90 (1%)</td>
</tr>
<tr>
<td>Retinal and Glaucoma</td>
<td>3/90 (3%)</td>
</tr>
<tr>
<td>Retinal and Cataracts</td>
<td>5/90 (6%)</td>
</tr>
<tr>
<td>Glaucoma and Cataracts</td>
<td>4/90 (4%)</td>
</tr>
<tr>
<td>Glaucoma and Dry eye</td>
<td>1/90 (1%)</td>
</tr>
<tr>
<td>Uveitis only</td>
<td>1/90 (1%)</td>
</tr>
<tr>
<td>Asteroid Hyalosis only</td>
<td>1/90 (1%)</td>
</tr>
</tbody>
</table>
Number of ocular comorbidities, mean (SD) 1.2 (0.5)
Number of non-ocular comorbidities, mean (SD) 1.6 (1.7)

Table 4-3. Summary of questionnaire scores for all participants.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Mean score (SD)</th>
<th>Minimum score</th>
<th>Maximum score</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTO</td>
<td>0.88 (0.23)</td>
<td>0</td>
<td>1.00</td>
<td>85</td>
</tr>
<tr>
<td>NEI VFQ-25</td>
<td>84.71 (11.61)</td>
<td>54.72</td>
<td>98.33</td>
<td>90</td>
</tr>
<tr>
<td>CES-D</td>
<td>6.79 (6.39)</td>
<td>0</td>
<td>27.00</td>
<td>90</td>
</tr>
<tr>
<td>PSQI</td>
<td>6.58 (3.00)</td>
<td>2.00</td>
<td>15.00</td>
<td>88</td>
</tr>
<tr>
<td>HADS-A</td>
<td>2.83 (2.56)</td>
<td>0</td>
<td>12.00</td>
<td>90</td>
</tr>
<tr>
<td>CIQ</td>
<td>14.46 (4.07)</td>
<td>2.00</td>
<td>23.75</td>
<td>88</td>
</tr>
</tbody>
</table>

Table 4-4. Unadjusted effects of variables with preference-based HRQoL.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.00</td>
<td>0.840</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Completed more than high school</td>
<td>0.05</td>
<td>0.327</td>
</tr>
<tr>
<td>Living Arrangement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/Retirement home</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Home with others</td>
<td>-0.01</td>
<td>0.854</td>
</tr>
<tr>
<td>Use of Mobility Aid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid</td>
<td>0.02</td>
<td>0.740</td>
</tr>
<tr>
<td>Number of Non-ocular Comorbidities</td>
<td>0.01</td>
<td>0.399</td>
</tr>
<tr>
<td>Number of Ocular Comorbidities</td>
<td>0.07</td>
<td>0.305</td>
</tr>
</tbody>
</table>
Glaucoma
No \textit{Ref} 
Yes 0.04 0.516 
Retinal disease
No \textit{Ref} 
Yes -0.06 0.281 
Cataract
No \textit{Ref} 
Yes -0.09 0.195 
\textbf{Socioeconomic status during COVID-19}
less than $10,000 \textit{Ref} 
$10,001 - $25,000 -0.12 0.406 
$25,001 - $50,000 -0.17 0.231 
$50,001 - $75,000 -0.06 0.658 
$75,001 - $100,000 0.01 0.966 
$100,001 - $125,000 -0.10 0.535 
$125,001 - $150,000 
Greater than $150,000 -3.27 0.084 

\textbf{Table 4-5.} Unadjusted effects of variables with VRQoL.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.28</td>
<td>0.073</td>
</tr>
<tr>
<td>\textbf{Education}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less \textit{Ref}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed more than high school 5.46</td>
<td>\textbf{0.027}</td>
<td></td>
</tr>
<tr>
<td>\textbf{Living Arrangement}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/Retirement home \textit{Ref}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home with others 3.87</td>
<td>0.169</td>
<td></td>
</tr>
<tr>
<td>\textbf{Use of Mobility Aid}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid \textit{Ref}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid -6.31</td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td>\textbf{Number of Non-ocular Comorbidities}</td>
<td>-0.00</td>
<td>0.994</td>
</tr>
<tr>
<td>\textbf{Number of Ocular Comorbidities}</td>
<td>-6.24</td>
<td>\textbf{0.042}</td>
</tr>
</tbody>
</table>
### Glaucoma

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.88</td>
<td>0.284</td>
</tr>
</tbody>
</table>

### Retinal disease

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-7.57</td>
<td>0.004</td>
</tr>
</tbody>
</table>

### Cataract

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.22</td>
<td>0.709</td>
</tr>
</tbody>
</table>

### Socioeconomic status during COVID-19

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than $10,000</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>$10,001 - $25,000</td>
<td>-6.54</td>
<td>0.356</td>
</tr>
<tr>
<td>$25,001 - $50,000</td>
<td>-4.64</td>
<td>0.508</td>
</tr>
<tr>
<td>$50,001 - $75,000</td>
<td>-0.29</td>
<td>0.967</td>
</tr>
<tr>
<td>$75,001 - $100,000</td>
<td>5.53</td>
<td>0.484</td>
</tr>
<tr>
<td>$100,001 - $125,000</td>
<td>3.57</td>
<td>0.659</td>
</tr>
<tr>
<td>$125,001 - $150,000</td>
<td>-0.50</td>
<td>0.954</td>
</tr>
<tr>
<td>Greater than $150,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 4-6.** Unadjusted effects of variables with depressive symptoms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>0.918</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Completed more than high school</td>
<td>1.98</td>
<td>0.149</td>
</tr>
<tr>
<td><strong>Living Arrangement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/Retirement home</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Home with others</td>
<td>-0.05</td>
<td>0.974</td>
</tr>
<tr>
<td><strong>Use of Mobility Aid</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid</td>
<td>4.35</td>
<td>0.016</td>
</tr>
<tr>
<td><strong>Number of Non-ocular Comorbidities</strong></td>
<td>-0.00</td>
<td>0.994</td>
</tr>
<tr>
<td><strong>Number of Ocular Comorbidities</strong></td>
<td>2.10</td>
<td>0.227</td>
</tr>
</tbody>
</table>

Glaucoma
<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>0.688</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Completed more than high school</td>
<td>-0.01</td>
<td>0.989</td>
</tr>
<tr>
<td><strong>Living Arrangement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/ Retirement home</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Home with others</td>
<td>0.71</td>
<td>0.253</td>
</tr>
<tr>
<td><strong>Use of Mobility Aid</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid</td>
<td>0.58</td>
<td>0.428</td>
</tr>
<tr>
<td><strong>Number of Non-ocular Comorbidities</strong></td>
<td>0.11</td>
<td>0.492</td>
</tr>
<tr>
<td><strong>Number of Ocular Comorbidities</strong></td>
<td>0.53</td>
<td>0.438</td>
</tr>
<tr>
<td><strong>Glaucoma</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-7. Unadjusted effects of variables with anxiety symptoms.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>0.831</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Completed more than high school</td>
<td>0.82</td>
<td>0.212</td>
</tr>
<tr>
<td>Living Arrangement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/Retirement home</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Home with others</td>
<td>-1.17</td>
<td>0.115</td>
</tr>
<tr>
<td>Use of Mobility Aid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid</td>
<td>1.73</td>
<td>0.044</td>
</tr>
<tr>
<td>Number of Non-ocular Comorbidities</td>
<td>0.22</td>
<td>0.239</td>
</tr>
<tr>
<td>Number of Ocular Comorbidities</td>
<td>0.36</td>
<td>0.647</td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.56</td>
<td>0.417</td>
</tr>
</tbody>
</table>

Table 4-8. Unadjusted effects of variables with sleep quality.
### Retinal disease
- No \( \text{Ref} \) 0.57 0.416
- Yes

### Cataract
- No \( \text{Ref} \) 0.28 0.747
- Yes

### Socioeconomic status during COVID-19
- less than $10,000 \( \text{Ref} \)
- $10,001 - $25,000 -3.26 0.086
- $25,001 - $50,000 -3.26 0.083
- $50,001 - $75,000 -3.47 0.068
- $75,001 - $100,000 -4.43 0.037
- $100,001 - $125,000 -4.67 0.032
- $125,001 - $150,000
- Greater than $150,000 -2.50 0.282

### Table 4-9. Unadjusted effects of variables with social support and community integration.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.10</td>
<td>0.092</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed high school or less</td>
<td>( \text{Ref} )</td>
<td></td>
</tr>
<tr>
<td>Completed more than high school</td>
<td>-1.23</td>
<td>0.169</td>
</tr>
<tr>
<td><strong>Living Arrangement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home alone/ Nursing/Retirement home</td>
<td>( \text{Ref} )</td>
<td></td>
</tr>
<tr>
<td>Home with others</td>
<td>-0.67</td>
<td>0.509</td>
</tr>
<tr>
<td><strong>Use of Mobility Aid</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not use mobility aid</td>
<td>( \text{Ref} )</td>
<td></td>
</tr>
<tr>
<td>Uses mobility aid</td>
<td>-1.22</td>
<td>0.297</td>
</tr>
<tr>
<td><strong>Number of Non-ocular Comorbidities</strong></td>
<td>-0.50</td>
<td>0.047</td>
</tr>
<tr>
<td><strong>Number of Ocular Comorbidities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td>( \text{Ref} )</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.80</td>
<td>0.415</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Retinal disease

<table>
<thead>
<tr>
<th></th>
<th>Ref</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-3.06</td>
<td>0.001</td>
</tr>
</tbody>
</table>

### Cataract

<table>
<thead>
<tr>
<th></th>
<th>Ref</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.07</td>
<td>0.951</td>
</tr>
</tbody>
</table>

### Socioeconomic status during COVID-19

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Ref</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>less than $10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$10,001 - $25,000</td>
<td>-0.02</td>
<td>0.993</td>
</tr>
<tr>
<td>$25,001 - $50,000</td>
<td>0.33</td>
<td>0.900</td>
</tr>
<tr>
<td>$50,001 - $75,000</td>
<td>0.13</td>
<td>0.962</td>
</tr>
<tr>
<td>$75,001 - $100,000</td>
<td>3.38</td>
<td>0.254</td>
</tr>
<tr>
<td>$100,001 - $125,000</td>
<td>0.92</td>
<td>0.762</td>
</tr>
<tr>
<td>$125,001 - $150,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than $150,000</td>
<td>1.67</td>
<td>0.610</td>
</tr>
</tbody>
</table>

TTO: Time Tradeoff; NEI VFQ-25: National Eye Institute 25-Item Visual Function Questionnaire-25; CES-D: Center for Epidemiologic Studies Depression Scale; PSQI: Pittsburg Sleep Quality Index; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; CIQ: Community Integration Questionnaire; SD: standard deviation
**Table 4-10.** Coefficient Estimates (95% Confidence Interval) for the Backwards Stepwise Linear Regression Models of the Questionnaire Outcomes.

<table>
<thead>
<tr>
<th>Variables</th>
<th>NEI VFQ-25</th>
<th>CES-D</th>
<th>PSQI</th>
<th>HADS-A</th>
<th>CIQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinal disease</td>
<td>-7.92 (-12.81, -3.05)</td>
<td>2.50 (-0.43, 5.43)</td>
<td></td>
<td>-3.10 (-4.77, -1.43)</td>
<td></td>
</tr>
<tr>
<td>Number of non-ocular comorbidities</td>
<td>-1.66 (-3.01, -0.31)</td>
<td></td>
<td></td>
<td>-0.68 (-1.15, -0.22)</td>
<td></td>
</tr>
<tr>
<td>Use of a mobility aid</td>
<td>4.20 (0.46, 7.94)</td>
<td>1.73 (.05, 3.41)</td>
<td>0.58 (-0.87, 2.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td>-1.79 (-3.44, -0.15)</td>
<td></td>
</tr>
</tbody>
</table>

NEI VFQ-25: National Eye Institute 25-Item Visual Function Questionnaire-25; CES-D: Center for Epidemiologic Studies Depression Scale; PSQI: Pittsburg Sleep Quality Index; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; CIQ: Community Integration Questionnaire
4.4 Discussion

In this cross-sectional study, the preference-based HRQoL, VRQoL, depression and anxiety symptoms, and social support and community integration of seniors with various eye diseases were assessed. A total of 90 participants were included in the study and the results showed that the COVID-19 pandemic did not appear to have a large impact on the QoL of seniors with eye diseases. This section provides a detailed analysis and discussion of the results of the QoL assessment and the potential impact on health-related outcomes.

The present study revealed that the preference-based HRQoL of our study patients with eye diseases during the pandemic is likely quite good with a mean utility value of 0.88. Moreover, it doesn’t appear that any of the potential predictors had a significant level of impact on the HRQoL of seniors during the pandemic. The analysis of the present study also showed that these seniors with eye disease appeared to have good vision and only a slight loss in visual performance impacting their VRQoL during the pandemic. However, it was also shown that the presence of retinal disease and the number of non-ocular comorbidities had a significant negative impact on the participants' VRQoL.

Moreover, study participants appeared to have a low presence of depressive symptomatology. The backwards stepwise multivariable regression analysis revealed that the use of a mobility aid did appear to show a significant increase in depressive symptomatology. The level of anxiety appeared to be normal, and the quality of sleep appeared to be good overall among patients with eye diseases during the pandemic. Of note, the use of a mobility aid was found to negatively affect sleep quality but not the
presence of anxiety symptoms. Previously, sleep quality has been found to be associated with physical disability in older adults which may explain this relationship between the use of a mobility aid and poor sleep quality\textsuperscript{31}. On the other hand, an analysis on the levels of social support and community integration found that participants likely had moderate social support and community integration during the pandemic. Furthermore, it was revealed that the presence of retinal disease, number of non-ocular comorbidities, and education appeared to have significant negative effects on social support and community integration. Based on the key measures of QoL such as preference-based HRQoL, VRQoL levels of depression and anxiety, and access to social support and community integration, the above findings indicate that the QoL and wellness of the elderly with eye diseases appears to be good.

However, it is important to note that there are studies conducted during this period that highlighted the need for further research to ascertain the impact of COVID-19 on the QoL of the elderly with eye diseases. For instance, a systematic review by Zaher et al.\textsuperscript{32} showed that there was a 36\% increase in the fear of vision loss due to an increased risk of missing appointments and a 48\% increase in the fear of contracting the virus due to office visits. Therefore, a future survey study focusing on gathering data about the fear of vision loss due to an increased risk of missing appointments and fear of contracting the virus due to office visits among eye disease patients would shed more light on the overall QoL of patients during the ongoing pandemic. Further, a prospective cross-sectional comparative study by Shalaby et al.\textsuperscript{33} found that the pandemic affected visually impaired people which results in diminished QoL. Moreover, majority of seniors who have vision loss tend to experience depressive symptoms \textsuperscript{34}. The results of our study resonate that community
integration and social support appear to be the lowest among the study population. This finding concurs with the view that containment measures of the pandemic such as lockdowns, social distancing, and curfews may have potentially impacted the lives of seniors with eye diseases.

Interestingly, the results of the preference-based HRQoL in this current study seem to agree with those of previous studies performed in the same location and setting. A previous study by Thomas et al.\textsuperscript{35} investigated the preference-based HRQoL among patients with glaucoma and diabetic retinopathy. Another previous study by Uruthiramoorthy et al.\textsuperscript{36} investigated the preference-based HRQoL among patients with glaucoma. Both studies reported relatively high mean utility values from 0.89 to 0.94 which is similar to the value of 0.88 found in the current study using the same TTO technique. These similarities may be suggestive that perhaps the QoL of the patients at this location is relatively high due to the services and facilities provided by the Ivey Eye Institute or due to the environment of London, Ontario in general.

Further, the study by Uruthiramoorthy et al\textsuperscript{36} found that living arrangements and the use of a mobility aid were significant predictors of VRQoL. Additionally, the study by Uruthiramoorthy et al\textsuperscript{36} found age, sex, income, living arrangement, and use of mobility aids to be predictors of social support and community integration. The difference seen between the predictor variables in the two studies may be due to a multitude of factors such as the COVID-19 pandemic conditions, different time periods, general eye disease patients versus glaucoma only patients, or the senior patient population.
4.4.1 Limitations

While the current study provides valuable information on the QoL of seniors with eye diseases, there were some limitations. A potential limitation stems from the use of convenience sampling which is associated with sampling bias \(^{37}\). Of note, many participants in our study were identified as being white and not requiring the use of a mobility aid; both of which are characteristics associated with a higher QoL\(^{38,39}\). As a result, this means that the results may not be representative of the actual population and that they are likely not entirely generalizable to other populations of seniors with eye diseases\(^{40}\).

This study was also limited by the number of included participants. As with most studies, more participants would allow for greater power and a greater ability to detect differences that are present. As such, a greater number of participants may have resulted in the detection of a significant impact on outcome measures like preference-based HRQoL.

Two other limitations of this study are inherent to the cross-sectional design that was used. The first of which is that in a cross-sectional design one cannot necessarily determine whether the exposure did precede the outcome\(^{41}\). As such, in the current study it is not entirely certain as to whether the study participants’ wellness was due to the presence of the COVID-19 pandemic conditions. The second of which is length bias which is systematic error due to selection of disproportionate numbers of long duration cases\(^{41}\). With this limitation in mind, it may be that many participants recruited in the current study were patients who have had their eye diseases for a long duration of time.
and been properly managed for a long time as well. As such, these patients may have been more adapted to their conditions and reported better QoL and wellness.

The final potential limitation of the study stems from healthy volunteer bias. Historically, volunteers in medical research tend to have a lower risk of mortality and other health problems compared to those who are not volunteers. Patients in the current study participated on a voluntary basis. As a result, this may mean that the results of the current study were biased in favor of higher QoL due to the study participants having healthier lifestyles than those who did not volunteer to participate. However, it was noted that of the 128 patients who were approached, 115 agreed to participate while 25 of these patients did not pass the inclusion/exclusion criteria. This suggests that the probability of such selection bias is likely low.

The current study has major implications, especially when it comes to focusing healthcare resources on the most vulnerable groups of the population. However, future studies in this area could focus on the relationship between QoL and eye diseases using eye disease-specific questionnaires. For example, instruments such as the Ocular Surface Disease Index for patients with DED and the Glaucoma Quality of Life-15 for patients with glaucoma could be studied. Generic preference-based measures of health to measure HRQoL such as the EuroQoL-5D and 36-item Short Form Survey could be used. Moreover, future studies with larger sample sizes focused on the QoL of seniors with eye diseases after the pandemic is completely over would be worthwhile conduct so that a comparison can be made to better understand the impact of the pandemic conditions on this population of patients.
4.5 Conclusions

Overall, the current study has found that the QoL among seniors with eye diseases appeared to be good. Measures of preference-based HRQoL and VRQoL appeared to be high. Indications of depression and anxiety symptoms were likely low, while community integration and social support appeared to be moderate. The presence of retinal disease and the number of non-ocular comorbidities both appeared to negatively impact VRQoL and social support and community integration. Education appeared to impact CIQ negatively. The use of a mobility aid appeared to negatively affect depressive symptoms and sleep quality.

4.6 References


1207.

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Chapter 5 Discussion

5 Introduction

This chapter begins with a statement of the overall goals of the thesis and each individual study in Section 5.1. Section 5.2 presents a summary of the results and the interpretations of each study’s results coinciding with each study’s objectives. Section 5.3 presents the strengths and limitations of each study. Section 5.4 discusses the future directions. Finally, the conclusions are presented in Section 5.5.

5.1 Overall Goals of the Thesis

The overall goal of this thesis was to explore the quality of life (QoL) of patients with eye diseases. This goal was accomplished through two research studies. The first study was a systematic review in Chapter 3 which aimed to systematically identify and summarize the health-related quality of life (HRQoL) values from direct preference elicitation techniques and generic preference-based measures (GPBMs) in North American patients with a variety of different eye diseases to provide important information to be utilized for making evaluations and resource allocation decisions. The second study was a cross-sectional survey study in Chapter 4 that aimed to characterize the preference-based HRQoL, vision-related QoL (VRQoL), depression and anxiety symptoms, sleep quality, social support, and community integration of seniors aged 65 and above with various eye diseases during the COVID-19 pandemic.
5.2 Summary of Results

In characterizing the summary scores of the SF-36 and SF-12, the systematic review showed that the mean physical component scores (PCS) ranged from 39.2 to 53.8 while the mean mental component scores (MCS) ranged from 48.7 to 62.9 in patients with glaucoma. In patients with age-related macular degeneration (ARMD), PCS scores ranged from 41.0 to 47.0 while MCS scores ranged from 38.0 to 52.0 across all severity classifications. Among the studies focusing on diabetic retinopathy (DR), mean PCS scores ranged from 46.0 to 49.6, and mean MCS scores ranged from 50.0 to 52.9. For the studies pertaining to patients with cataracts, the mean PCS values ranged from 43.2 to 46.1, while the MCS scores had a larger range from 54.0 to 82.1. Similarly, the included studies on patients with uveitis reported PCS and MCS scores with measures of central tendency ranging from 47.4 to 50.0 and 47.6 to 52.0 respectively. Finally, the studies focused on dry eye disease (DED) reported mean PCS and MCS values ranging from 45.3 to 48.8 and 44.6 to 51.0. Across each eye disease, overall physical component scores ranged from 39.2 to 53.8 suggesting potentially poor to average physical health though mental component scores ranged from 51.0 to 82.1 suggesting average to potentially good mental health. However, most measures of the central tendency of the scores appeared to be near 50 where PCS and MCS values can range between 0 to 100, and a mean (SD) of 50 (10) has been noted to be the PCS and MCS values of the US general population.

The systematic review also summarized the utility values of patients with eye disease revealing that the mean utility values of patients with glaucoma appeared to be consistent between 0.89 to 0.94. The mean utility values for collective patients with
ARMD were more variable ranging from 0.74 to 0.81. Similarly, the mean utility values of collective patients with DR ranged from 0.77 to 0.88. However, based on studies that reported utility values stratified by disease severity, mean utility values as low as 0.40 and as high as 0.96 were reported among groups of patients with more severe and less severe forms of ARMD respectively. Similarly, among studies that reported utility values stratified by severity of DR, mean utility values as low as 0.59 and as high as 0.92 were reported among groups of patients with more severe and less severe forms respectively. Mean utility scores for patients with cataracts were variable ranging from 0.66 to 0.85. Likewise, measures of central tendency for utility values of patients with uveitis ranged from 0.67 to 0.84. Finally, the mean utility values of collective patients living with DED appeared to be less variable between 0.78 to 0.82. However, among studies that reported utility values stratified by disease severity, mean utility values as low as 0.62 and as high as 0.81 were reported in patients with more severe and less severe forms of DED respectively. Of note, across non-stratified collective groups of patients with the eye diseases mentioned above, utility values ranged from 0.74 to 0.94 suggesting overall fair to good HRQoL. However, in general, the utility values across patients with ARMD, DR, uveitis, and DED appeared to be quite similar while the values in patients with glaucoma appear to be higher. This resonates with our results from the cross-sectional study.

The results of the cross-sectional study revealed that the overall QoL among seniors with eye diseases appeared to be good during the COVID-19 pandemic. Results from the data analysis showed that the outcomes of the HRQoL and VRQoL appeared to be good with a mean utility value of 0.88 and a mean summary score of 84.71. Sleep quality also appeared to be good with a mean summary score of 6.58. In addition, the
assessment of the depression and anxiety symptoms appeared to be low with mean summary scores of 6.79 and 2.56 respectively. The community integration and social support appeared to be moderate with a mean summary score of 14.46. The results also revealed that the presence of retinal disease and the number of non-ocular comorbidities both appeared to negatively impact VRQoL and social support and community integration. Greater education also appeared to impact social support and community integration negatively. Additionally, the use of a mobility aid appeared to negatively affect depressive symptoms and sleep quality. This could suggest patients with less mobility could have poor sleep quality and depressive symptoms.

The systematic review from Chapter 3 focuses on preference-based HRQoL of all eye disease patients in North America while the cross-sectional study from Chapter 4 looks at the wellness and more general QoL of a specific group of patients with eye diseases at a specific time (seniors during the COVID-19 pandemic). Together they provide a better picture of the QoL of patients with eye diseases. The findings from both Chapters 3 and 4 generally seem to indicate that the QoL among patients with eye disease appears to be good. In particular, the mean utility score of 0.88 was found in the cross-sectional study of Chapter 4. This utility score is relatively similar to those for glaucoma, DR, and some forms of ARMD in the systematic review of Chapter 3. Notably, a score of 0.88 appears to be high. This may be because while most patients in the cross-sectional study had glaucoma, retinal diseases, or cataracts, 40 of included patients reported having glaucoma making glaucoma the most prevalent disease in the study sample. Moreover, as shown in Chapter 3, the score of the utility values for glaucoma were also quite high from 0.89 to 0.94. As such, it may be due to the high prevalence of glaucoma in the study
sample that this mean utility score was quite high. Moreover, the results of the cross-sectional study indicating the low presence of depression and anxiety symptoms within the study sample seem to agree with the finding of suggesting average to potentially good mental health from the systematic review.

5.3 Strengths and Limitations

In conducting the systematic review to explore the QoL of North American patients with a variety of eye diseases, the outcomes of Chapter 3 could provide important information to policymakers to make economic assessments to improve the overall care of patients with different eye diseases. This is particularly a significant undertaking since sight is an important part of the health and wellbeing of senior citizens who tend to be the majority of individuals affected by eye diseases since it not only prevents health risks such as falls but also psychological disorders such as anxiety, stress, and depression that are known to have a negative impact on their QoL\(^2\). Additionally, in documenting and assessing the QoL among senior patients during the COVID-19 pandemic, the outcomes of Chapter 4 have the potential to determine the overall impact of the pandemic, especially in relation to health and wellbeing of seniors. Furthermore, the findings from Chapter 4 could provide a reservoir of information to help improve the future quality of care during non-COVID-19 conditions and potential future pandemic situations.

However, while both studies provide valuable information, both have certain limitations. Regarding the systematic review, of the 39 included studies, 16 were deemed to be of a low risk of bias. Regardless of their quality, all studies were included in the review due to the limited availability of evidence. Another limitation of the systematic review stems from the fact that a location restriction of North America was placed to
systematically gather consistent data on HRQoL. Thus, the values of HRQoL from the systematic review may not be representative of those in other countries and articles that measured HRQoL among other eye conditions were excluded from the review. Additionally, the review had a restriction of adult patients and as a result, the review does not include information on eye diseases that are much more common in pediatric populations. Though, it should be emphasized that the key objective of this systematic review was to determine and summarize the HRQoL values in adult patients with various eye diseases in North America.

Regarding the cross-sectional study assessing QoL among seniors during the COVID-19 pandemic, one of its limitations was the use of a convenience sampling technique. This limits the generalizability of the findings to other populations of seniors with eye diseases as well as it is possible that there are other factors that may influence an individual’s QoL during COVID-19³. The study may have also been limited by healthy volunteer bias. This is a type of bias that occurs when a study participant is at a lower risk of developing the disease because they are in fact healthy⁴. Nonetheless, it was noted that of the 128 patients who were approached, 115 agreed to participate, while 25 of these patients did not pass the inclusion/exclusion criteria. This suggests that the probability of such selection bias is likely low.

5.4 Future Directions

One of the key areas of consideration for future research is the need for more data to be extracted from a large sample of patients specific to each eye disease and disease severity to increase the generalizability of the findings as well as to improve the power of the study. In this regard, there is a need for more data to be collected to gain a better
understanding of the impact of the pandemic on the QoL among seniors with different age groups, specific eye diseases as well as disease severity. This also highlights another area of consideration; that is to use different data collection tools when assessing QoL among the target population. While the current cross-sectional study used a plethora of tools such as the time trade-off technique, 25-item version National Eye Institute Visual Function Questionnaire, Pittsburgh Sleep Quality Index, Hospital Anxiety and Depression Scale–Anxiety Subscale, and Center for Epidemiologic Studies – Depression scale, there are many other tools that can be used to measure QoL as highlighted in the systematic review. As such, additional measures such as the EuroQoL-5D, 36-item and 12-item Short Form Surveys, and Health Utility Index questionnaires may be used to provide a more comprehensive understanding of the overall health status of seniors with eye diseases.

Another area of consideration for future research is the need to improve the health and wellbeing of patients with eye diseases. As noted by previous studies, eye disease among elderly patients is associated with poor health, low HRQoL, and increased mortality. Moreover, worse QoL is typically found among people with more severe forms of eye diseases with worse visual acuity. As such, while the current studies provide evidence of the QoL among general patients with eye diseases and seniors with eye diseases during pandemic times, future studies could apply the findings to develop further interventions to improve the health and wellbeing of patients with eye diseases, with a specific focus on wellness. Generally, wellness refers to the state of being physically, mentally, and socially fit and healthy. Wellness can also be defined as a state of physical, mental, social, and spiritual health that enables individuals to effectively cope with the demands of everyday life. Future studies could assess different aspects that
affect wellness such as other mood disorders including bipolar disorder along with anxiety- and depression-like in this cross-sectional study. Furthermore, future studies could also take a greater focus on assessing spiritual health as a part of wellness.

Finally, future studies focusing on determining how the QoL of older adults is affected more specifically by each case of an ophthalmological condition such as glaucoma and DED could use relevant measures. Questionnaires designed to determine how the QoL of patients with specific eye diseases could be used. For example, future studies could use instruments like the Glaucoma Quality of Life-15 for patients with glaucoma and the Ocular Surface Disease Index for patients with DED, new instruments like the Glaucoma Utility Instrument which is more tailored towards patients with glaucoma unlike the traditional preference elicitation methods and can also yield utility values for economic evaluations. Doing so may provide a better understanding of the overall QoL of older adults with these specific eye diseases.

5.5 Conclusions

Overall, the QoL of patients with eye diseases in North America appears to be good. The HRQoL among patients with various eye diseases was generally similar. In particular, there was similar HRQoL across patients with glaucoma, ARMD, diabetic retinopathy (DR), cataracts, uveitis, and dry eye disease (DED) based on the SF-12 and SF-36. Utility values across patients with ARMD, DR, cataracts, uveitis, and DED also provided similar results, however, the values in patients with glaucoma appeared to be higher. Moreover, QoL among seniors with eye diseases appeared to be generally good during the COVID-19 pandemic. HRQoL, VRQoL, and sleep quality appeared to be good. Depression and anxiety symptoms appeared to be low, while community
integration and social support were moderate. The presence of retinal disease and the number of non-ocular comorbidities both appeared to negatively impact VRQoL and social support and community integration suggesting that retina patients with a number of non-ocular comorbidities had poor vision-related QoL and poor social support and community integration. Education appeared to impact CIQ negatively suggesting that patients with education of more than high school had poorer social support and community integration. The use of a mobility aid appeared to negatively affect depressive symptoms and sleep quality.

5.6 References


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Appendices

Appendix A. Research Ethics Board approval letter

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Date: 21 October 2021

To: Dr. Monali Malvankar

Project ID: 115875

Study Title: Impact of COVID-19 on Quality of Life of Seniors with Eye Disease and Implementations to Improve Wellness

Application Type: HSREB Initial Application

Review Type: Delegated

Full Board Reporting Date: 02 November 2021

Date Approval Issued: 21 Oct 2021

REB Approval Expiry Date: 21 Oct 2022

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Dear Dr. Monali Malvankar

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals and mandated training must also be obtained prior to the conduct of the study.

Documents Approved:

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No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2), the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP), Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions. Sincerely,
Appendix B. Time Trade-Off (TTO)

How many years do you expect to live? ________________ years

Suppose there was a new technology that could restore your eyesight to perfectly healthy eyes. The technology always works but decreases the length of time you live.

What is the maximum number of years, if any, that you would be willing to give up if you could receive this technology and have perfect vision for your remaining years?

______________________ years

Appendix C. National Eye Institute Visual Function Questionnaire (VFQ-25)

PART 1 - GENERAL HEALTH AND VISION

1. In general, would you say your overall health is: (Circle One)
   - Excellent.................... 1
   - Very Good................... 2
   - Good.......................... 3
   - Fair........................... 4
   - Poor........................... 5

2. At the present time, would you say your eyesight using both eyes (with glasses or contact lenses, if you wear them) is excellent, good, fair, poor, or very poor or are you completely blind?
   (Circle One)
   - Excellent.................... 1
   - Good......................... 2
   - Fair........................... 3
   - Poor........................... 4
   - Very Poor.................... 5
   - Completely Blind........... 6
3. How much of the time do you worry about your eyesight? (Circle One)
   None of the time........................ 1
   A little of the time..................... 2
   Some of the time........................ 3
   Most of the time........................ 4
   All of the time?......................... 5

4. How much pain or discomfort have you had in and around your eyes (for example, burning, itching, or aching)? Would you say it is: (Circle One)
   None........................................... 1
   Mild.............................................. 2
   Moderate................................. 3
   Severe, or................................. 4
   Very severe?............................. 5

PART 2 - DIFFICULTY WITH ACTIVITIES
The next questions are about how much difficulty, if any, you have doing certain activities
wearing your glasses or contact lenses if you use them for that activity.
5. How much difficulty do you have reading ordinary print in newspapers? Would you say you have: (Circle One)
   No difficulty at all........................................... 1
   A little difficulty............................................. 2
   Moderate difficulty....................................... 3
   Extreme difficulty....................................... 4
   Stopped doing this because of your eyesight.... 5
   Stopped doing this for other reasons or not interested in doing this......................... 6

6. How much difficulty do you have doing work or hobbies that require you to see well up close, such as cooking, sewing, fixing things around the house, or using hand tools? Would you say:
   (Circle One)
   No difficulty at all........................................... 1
   A little difficulty............................................. 2
   Moderate difficulty....................................... 3
   Extreme difficulty....................................... 4
   Stopped doing this because of your eyesight.... 5
   Stopped doing this for other reasons or not interested in doing this......................... 6

7. Because of your eyesight, how much difficulty do you have finding something on a crowded shelf? (Circle One)
8. How much difficulty do you have reading street signs or the names of stores? (Circle One)

- No difficulty at all ................................................................. 1
- A little difficulty ........................................................................ 2
- Moderate difficulty .................................................................... 3
- Extreme difficulty ...................................................................... 4

Stopped doing this because of your eyesight .... 5
Stopped doing this for other reasons or not interested in doing this ........ 6

9. Because of your eyesight, how much difficulty do you have going down steps, stairs, or curbs in dim light or at night? (Circle One)

- No difficulty at all ........................................................................ 1
- A little difficulty ........................................................................... 2
- Moderate difficulty ...................................................................... 3
- Extreme difficulty ....................................................................... 4

Stopped doing this because of your eyesight .... 5
Stopped doing this for other reasons or not interested in doing this ........ 6

10. Because of your eyesight, how much difficulty do you have noticing objects off to the side while you are walking along? (Circle One)

- No difficulty at all ........................................................................ 1
- A little difficulty ........................................................................... 2
- Moderate difficulty ...................................................................... 3
- Extreme difficulty ....................................................................... 4

Stopped doing this because of your eyesight .... 5
Stopped doing this for other reasons or not interested in doing this ........ 6

11. Because of your eyesight, how much difficulty do you have seeing how people react to things you say? (Circle One)

- No difficulty at all ........................................................................ 1
- A little difficulty ........................................................................... 2
- Moderate difficulty ...................................................................... 3
- Extreme difficulty ....................................................................... 4

Stopped doing this because of your eyesight .... 5
Stopped doing this for other reasons or not interested in doing this ........ 6
12. Because of your eyesight, how much difficulty do you have picking out and matching your own clothes? (Circle One)

- No difficulty at all............................................ 1
- A little difficulty............................................. 2
- Moderate difficulty......................................... 3
- Extreme difficulty.......................................... 4
- Stopped doing this because of your eyesight..... 5
- Stopped doing this for other reasons or not interested in doing this........ 6

13. Because of your eyesight, how much difficulty do you have visiting with people in their homes, at parties, or in restaurants? (Circle One)

- No difficulty at all............................................ 1
- A little difficulty............................................. 2
- Moderate difficulty......................................... 3
- Extreme difficulty.......................................... 4
- Stopped doing this because of your eyesight..... 5
- Stopped doing this for other reasons or not interested in doing this........ 6

14. Because of your eyesight, how much difficulty do you have going out to see movies, plays, or sports events? (Circle One)

- No difficulty at all............................................ 1
- A little difficulty............................................. 2
- Moderate difficulty......................................... 3
- Extreme difficulty.......................................... 4
- Stopped doing this because of your eyesight..... 5
- Stopped doing this for other reasons or not interested in doing this........ 6

15. Are you currently driving, at least once in a while? (Circle One)

- Yes....................... 1 Skip To Q 15c
- No ..................... 2

15a. IF NO: Have you never driven a car or have you given up driving? (Circle One)

- Never drove....... 1 Skip To Part 3, Q 17
- Gave up.......... 2

15b. IF YOU GAVE UP DRIVING: Was that mainly because of your eyesight, mainly for some other reason, or because of both your eyesight and other reasons? (Circle One)

- Mainly eyesight......................... 1 Skip To Part 3, Q 17
- Mainly other reasons .................... 2 Skip To Part 3, Q 17
- Both eyesight and other reasons .... 3 Skip To Part 3, Q 17
15c. IF CURRENTLY DRIVING: How much difficulty do you have driving during the daytime in familiar places? Would you say you have: (Circle One)

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</table>

16. How much difficulty do you have driving at night? Would you say you have: (Circle One)

<table>
<thead>
<tr>
<th>Difficulty Level</th>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>No difficulty at all</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A little difficulty</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Moderate difficulty</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Extreme difficulty</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Stopped doing this because of your eyesight</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Difficult Reason</th>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopped doing this for other reasons or not interested in doing this</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

16A. How much difficulty do you have driving in difficult conditions, such as in bad weather, during rush hour, on the freeway, or in city traffic? Would you say you have: (Circle One)

<table>
<thead>
<tr>
<th>Difficulty Level</th>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>No difficulty at all</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A little difficulty</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Moderate difficulty</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Extreme difficulty</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Stopped doing this because of your eyesight</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Difficult Reason</th>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopped doing this for other reasons or not interested in doing this</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

PART 3: RESPONSES TO VISION PROBLEMS

The next questions are about how things you do may be affected by your vision. For each one, please circle the number to indicate whether for you the statement is true for you all, most, some, a little, or none of the time. (Circle One On Each Line)

<table>
<thead>
<tr>
<th>Question</th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 Do you accomplish less than you would like because of your vision?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>18 Are you limited in how long you can work or do other activities because</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>19</td>
<td>How much does pain or discomfort in or around your eyes, for example, burning, itching, or aching, keep you from doing what you’d like to be doing?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
For each of the following statements, please circle the number to indicate whether for you the statement is definitely true, mostly true, mostly false, or definitely false for you or you are not sure. (Circle One On Each Line)

<table>
<thead>
<tr>
<th></th>
<th>Definitely true</th>
<th>Mostly true</th>
<th>Not sure</th>
<th>Mostly false</th>
<th>Definitely false</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>I stay home most of the time because of my eyesight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>21</td>
<td>I feel frustrated a lot of the time because of my eyesight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22</td>
<td>I have much less control over what I do, because of my eyesight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23</td>
<td>Because of my eyesight, I have to rely too much on what other people tell me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>I need a lot of help from others because of my eyesight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>I worry about doing things that will embarrass myself or others, because of my eyesight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Appendix D. Hospital Anxiety and Depression Scale – Anxiety subscale (HADS-A)**

Tick the box beside the reply that is closest to how you have been feeling in the past week. Don’t take too long over you replies: your immediate is best.
1. I feel tense or 'wound up':

- Most of the time
- A lot of the time
- From time to time, occasionally
- Not at all

2. I feel tense or 'wound up':

- Very definitely and quite badly
- Yes, but not too badly
- A little, but it doesn't worry me
- Not at all

3. Worrying thoughts go through my mind:

- A great deal of the time
- A lot of the time
- From time to time, but not too often
- Not at all

4. I can sit at ease and feel relaxed:

- Definitely
- Usually
- Not Often
- Not at all

5. I get a sort of frightened feeling like 'butterflies' in the stomach:

- Not at all
- Occasionally
- Quite Often
- Very Often

6. I feel restless as I have to be on the move:

- Very much indeed
- Quite a lot
- Not very much
Appendix E. Center for Epidemiologic Studies – Depression scale (CES-D)

Instructions: Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

<table>
<thead>
<tr>
<th>7. I get sudden feelings of panic:</th>
<th>□ Not at all</th>
<th>□ Very often indeed</th>
<th>□ Quite a lot</th>
<th>□ Not very often</th>
<th>□ Not at all</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Rarely or none of the time (less than 1 day)</th>
<th>Some or a little of the time (1-2 days)</th>
<th>Occasionally or a moderate amount of time (3-4 days)</th>
<th>Most or all of the time (5-7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I was bothered by things that usually don’t bother me.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2.</td>
<td>I did not feel like eating; my appetite was poor.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3.</td>
<td>I felt that I could not shake off the blues even with help from my family or friends.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>4.</td>
<td>I felt I was just as good as other people.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>5.</td>
<td>I had trouble keeping my mind on what I was doing.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>6.</td>
<td>I felt depressed.</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7. I felt that everything I did was an effort.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I felt hopeful about the future.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I thought my life had been a failure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I felt fearful.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. My sleep was restless.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I was happy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I talked less than usual.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. People were unfriendly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. I enjoyed life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. I had crying spells.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. I felt sad.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. I felt that people disliked me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. I could not get “going.”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix F. Pittsburgh Sleep Quality Index (PSQI)

PITTSBURGH SLEEP QUALITY INDEX (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?
   USUAL BED TIME ____________________________

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?
   NUMBER OF MINUTES _________________________

3. During the past month, when have you usually gotten up in the morning?
   USUAL GETTING UP TIME _____________________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)
   HOURS OF SLEEP PER NIGHT __________________

INSTRUCTIONS: For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you...

   (a) ...cannot get to sleep within 30 minutes
   (b) ...wake up in the middle of the night or early morning
   (c) ...have to get up to use the bathroom
   (d) ...cannot breathe comfortably
   (e) ...cough or snore loudly
   (f) ...feel too cold
   (g) ...feel too hot
   (h) ...had bad dreams
   (i) ...have pain
   (j) Other reason(s), please describe

   How often during the past month have you had trouble sleeping because of this?

   Not during the past month □ Less than once a week □ Once or twice a week □ Three or more times a week □

PSQI Page 1
6. During the past month, how would you rate your sleep quality overall?  

<table>
<thead>
<tr>
<th>Very good</th>
<th>Fairly good</th>
<th>Fairly bad</th>
<th>very bad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?  

<table>
<thead>
<tr>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?  

<table>
<thead>
<tr>
<th>No problem at all</th>
<th>Only a very slight problem</th>
<th>Somewhat of a problem</th>
<th>A very big problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?  

<table>
<thead>
<tr>
<th>No bed partner or roommate</th>
<th>Partner/roommate in other room</th>
<th>Partner in same room, but not same bed</th>
<th>Partner in same bed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?  

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

(a) ...loud snoring  

(b) ...long pauses between breaths while asleep  

(c) ...legs twitching or jerking while you sleep  

(d) ...episodes of disorientation or confusion during sleep  

(e) Other restlessness while you sleep; please describe  

<table>
<thead>
<tr>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PSQI Page 2
**Appendix G. Community Integration Questionnaire (CIQ)**

1. Who usually does the shopping for groceries or other necessities in your household?
   - Yourself alone
   - Yourself and someone else
   - Someone else

2. Who usually prepares meals in your household?
   - Yourself alone
   - Yourself and someone else
   - Someone else

3. In your home who usually does the everyday housework?
   - Yourself alone
   - Yourself and someone else
   - Someone else
   - Not applicable

4. Who usually cares for the children in your home?
   - Yourself alone
   - Yourself and someone else
   - Someone else
   - Not applicable

5. Who usually plans social arrangements such as get-togethers with family and friends?
   - Yourself alone
   - Yourself and someone else
   - Someone else
   - Not applicable

6. Who usually looks after your personal finances, such as banking or paying bills?
   - Yourself alone
   - Yourself and someone else
   - Someone else

7. Approximately how many times a month do you usually participate in shopping outside your home?
   - Never
   - 1-4 times
   - 5 or more

8. Approximately how many times a month do you usually participate in leisure activities such as movies, sports, restaurants etc.
   - Never
   - 1-4 times
   - 5 or more

9. Approximately how many times a month do you usually visit your friends or relatives?
   - Never
   - 1-4 times
   - 5 or more

10. When you participate in leisure activities do you usually do this alone or with others?
    - Mostly alone
    - Mostly with friends
    - Mostly with family members
    - With a combination of family and friends

11. Do you have a best friend with whom you confide?
    - Yes
    - No

12. How often do you travel outside the home?
    - Almost every day
    - Almost every week
    - Seldom/never (less than once per week)
13. Please choose the answer that best corresponds to your current (during the past month) work situation:

- Full-time (more than 20 hours/week)
- Part-time (less than or equal to 20 hours/week)
- Not working, but actively looking for work
- Not working, not looking for work
- Not applicable (retired, disability)

14. Please choose the answer that best corresponds to your current (during the past month) school or training program situation:

- Full-time
- Part-time
- Not attending school, or training program
- Not applicable (retired, disability)

15. In the past month, how often did you engage in volunteer activities

- Never
- 1-4 times
- 5 or more

Appendix H. Search Strategies

Embase

<table>
<thead>
<tr>
<th>#</th>
<th>Searches</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;quality of life&quot;/ or quality adjusted life year/</td>
<td>563842</td>
</tr>
<tr>
<td>2</td>
<td>(quality of life or life quality or hql or hqol or qol or hrqol or hrql or health-related quality or health related quality of life).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>699058</td>
</tr>
<tr>
<td>3</td>
<td>(quality of wellbeing or quality of well being or quality of well-being or qwb).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>679</td>
</tr>
<tr>
<td>4</td>
<td>(qaly* or quality adjusted life year* or quality-adjusted life year).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug</td>
<td>37381</td>
</tr>
<tr>
<td>5</td>
<td>(time trade off or time tradeoff or tto).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>3128</td>
</tr>
<tr>
<td>6</td>
<td>(visual analog scale* or VAS).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>113463</td>
</tr>
<tr>
<td>7</td>
<td>(standard gamble* or SG*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
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</tr>
<tr>
<td>8</td>
<td>(EQ-5D or eq5d or eq 5d or euroqol or euro qol or euroqol-5d).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>25503</td>
</tr>
<tr>
<td>9</td>
<td>(SF-36 or sf 36 or sf36 or sfthirtysix or sf thirtysix or sf thirty six or short form 36 or short form thirty six or short form thirtysix or shortform 36).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
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<tr>
<td>10</td>
<td>(SF-6D or sf 6d or sf6d or sf six d or short form 6d or short form six d or shortform 6d or Short-Form Six-Dimension or Short Form Six Dimension).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>1751</td>
</tr>
<tr>
<td>11</td>
<td>(SF-12 or sf 12 or sf12 or sf twelve or sf twelve or short form 12 or short form twelve or shortform 12).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>12975</td>
</tr>
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<td>12</td>
<td>(Health Utility Index or Health Utilities Index or HUI or hui1 or hui2 or hui3).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name,</td>
<td>4311</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Identifier</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>13</td>
<td>eye disease/ or Eye disease*.mp. or ocular disease*.mp. or ophthal* disease.mp. or ophthal* condition.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>73881</td>
</tr>
<tr>
<td>14</td>
<td>glaucoma/ or low tension glaucoma/ or primary glaucoma/ or open angle glaucoma/ or neovascular glaucoma/ or secondary glaucoma/ or glaucoma.mp. or open-angle glaucoma.mp. or open angle glaucoma.mp. or primary open-angle glaucoma.mp. or primary open angle glaucoma.mp. or OAG.mp. or POAG.mp. or low tension glaucoma.mp. or low-tension glaucoma.mp. or Angle-Closure Glaucoma.mp. or Angle Closure Glaucoma.mp. or Normal-Tension Glaucoma.mp. or Normal Tension Glaucoma.mp. or NTG.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
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</tr>
<tr>
<td>15</td>
<td>retina macula age related degeneration/ or macular degeneration/ or age-related macular degeneration.mp. or ARMD.mp. or AMD.mp. or macular degeneration.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>52221</td>
</tr>
<tr>
<td>16</td>
<td>diabetic retinopathy/ or diabetic eye disease.mp. or diabetic retinopathy.mp. or DR.mp. or retinopathy.mp. or diabetic maculopathy.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>341065</td>
</tr>
<tr>
<td>17</td>
<td>retina macula edema/ or macular edema/ or macular edema.mp. or diabetic macular edema.mp. or DME.mp. or ME.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]</td>
<td>89590</td>
</tr>
<tr>
<td>18</td>
<td>retina vein occlusion/ or retinal vein occlusion.mp. or RVO.mp. or central retinal vein occlusion.mp. or peripheral retinal vein occlusion.mp. or CRVO.mp. or</td>
<td>10241</td>
</tr>
<tr>
<td>ID</td>
<td>Search Terms</td>
<td>Count</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>19</td>
<td>retina macula hole/ or macular hole*.mp. or retinal hole*.mp. or retinal tear*.mp. or retinal break.mp. or retinal breaks.mp. or retinal perforation*.mp.</td>
<td>11031</td>
</tr>
<tr>
<td>20</td>
<td>retina detachment/ or retinal detachment.mp. or detached retina.mp.</td>
<td>4219</td>
</tr>
<tr>
<td>21</td>
<td>cataract/ or senile cataract/ or cataract*.mp.</td>
<td>112954</td>
</tr>
<tr>
<td>22</td>
<td>dry eye/ or keratoconjunctivitis sicca/ or dry eye*.mp. or dry eye disease.mp. or dry eye syndrome.mp. or DED.mp. or DES.mp. or keratoconjunctivitis sicca.mp. or KCS.mp. or dysfunctional tear syndrome.mp. or lacrimal keratoconjunctivitis.mp. or evaporative tear deficiency.mp. or aqueous tear deficiency.mp.</td>
<td>545930</td>
</tr>
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<td>21</td>
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<td>24</td>
<td>&quot;GO&quot;:ab,ti,kw</td>
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<td>&quot;Amblyopia&quot; or &quot;lazy eye&quot;:ab,ti,kw</td>
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<td>31</td>
<td>#27 and #28 and #29 and #30</td>
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Grey Literature

Web of Science

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<td>(standard gamble* or SG)</td>
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<td>5</td>
<td>(visual analog scale* or VAS )</td>
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<tr>
<td>3</td>
<td>AB= (qaly* or quality adjusted life year*)</td>
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<td>2</td>
<td>AB= (quality of wellbeing or quality of well being or quality of well-being)</td>
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<td>1</td>
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**Appendix I. Kappa Statistics Calculations**

**Kappa Statistics (Title and Abstract Screening)**

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<th>Hyunsoo</th>
</tr>
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<tbody>
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</tr>
<tr>
<td></td>
<td>Include</td>
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<tr>
<td>Include</td>
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</tr>
<tr>
<td>Exclude</td>
<td>143</td>
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<tr>
<td>Total</td>
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\[
Kappa = \frac{P(O) - P(E)}{1 - P(E)}
\]

\[
P(O) = \frac{371 + 2890}{3481}
\]
\[ P(O) = 0.93679977 \]

\[ P(E) = \frac{(448 \times 514) + (3033 \times 2967)}{3481^2} \]

\[ P(E) = 0.761649587 \]

\[ \text{Kappa} = \frac{P(O) - P(E)}{1 - P(E)} \]

\[ \text{Kappa} = \frac{0.93679977 - 0.761649587}{1 - 0.761649587} \]

\[ \text{Kappa} = 0.734843213 \]
Kappa Statistics (Full text Screening)

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<th>Hyunsoo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian</td>
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<tr>
<td></td>
<td>10</td>
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<td>49</td>
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</table>

\[
Kappa = \frac{P(O) - P(E)}{1 - P(E)}
\]

\[
P(O) = \frac{39 + 374}{458}
\]

\[
P(O) = 0.901746725
\]

\[
P(E) = \frac{(49 \times 74) + (409 \times 384)}{458^2}
\]

\[
P(E) = 0.766013234
\]

\[
Kappa = \frac{P(O) - P(E)}{1 - P(E)}
\]

\[
Kappa = \frac{0.901746725 - 0.766013234}{1 - 0.766013234}
\]

\[Kappa = 0.500090461\]
### Appendix J. Risk of Bias Assessment Tables


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<td>Definitely yes (low risk of bias)</td>
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<td>Lee 2003</td>
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## Tool to Assess Risk of Bias in Cohort Studies.

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<th>1. Was selection of exposed and non-exposed cohorts drawn from the same population?</th>
<th>2. Can we be confident in the assessment of exposure?</th>
<th>3. Can we be confident that the outcome of interest was not present at start of study?</th>
<th>4. Did the study match exposed and unexposed for all variables that are associated with the outcome of interest or did the statistical analysis adjust for these prognostic variables?</th>
<th>5. Can we be confident in the assessment of the presence or absence of prognostic factors?</th>
<th>6. Can we be confident in the assessment of outcome?</th>
<th>7. Was the follow up of cohorts adequate?</th>
<th>8. Were co-interventions similar between groups?</th>
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<td>Usually yes</td>
<td>Probably yes</td>
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## Tool to Assess Risk of Bias in Randomized Controlled Trials.

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<td>Definitely yes (low risk of bias)</td>
<td>Probablly yes</td>
<td>Definitely no (high risk of bias)</td>
<td>Probably no</td>
<td>Unclear information on allocation sequence generation, Moderate risk</td>
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<td>Probablly yes</td>
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<td>Probably no</td>
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<td>Definitely no (high risk of bias)</td>
<td>Definitely no (high risk of bias)</td>
<td>Definitely yes (low risk of bias)</td>
<td>Probably no</td>
<td>Probably yes</td>
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<td>Definitely yes (low risk of bias)</td>
<td>Definitely yes (low risk of bias)</td>
<td>Definitely yes (low risk of bias)</td>
<td>Probablly no</td>
<td>Probably no</td>
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<td>Naik 2013</td>
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<td>Probably yes</td>
<td>Probablly yes</td>
<td>Probably yes</td>
<td>Probablly yes</td>
<td>Probablly yes</td>
<td>Definitely yes (low risk of bias)</td>
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Tool to Assess Risk of Bias in Longitudinal Symptom Research Studies Aimed at the General Population.

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<th>1. Is the source population (sampling frame) representative of the general population?</th>
<th>2. Is the assessment of the outcome accurate both at baseline and at follow-up?</th>
<th>3. Is there little missing data?</th>
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<td>Definitely no (high risk of bias)</td>
<td>No information on missing data, High risk</td>
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<tr>
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**Appendix K. Extra Data Extraction**

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<th>Author and Year of Publication</th>
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<td>Social functioning: 52 (35, 57)</td>
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<td>Social functioning</td>
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<tr>
<td>Mental health</td>
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Treatment group: SF-36 Baseline Mean (SE)

Implant group:
- PCS: 46.16 (1.18)
- MCS: 47.75 (1.31)

Systemic group:
- PCS: 48.09 (1.13)
- MCS: 48.58 (1.20)

**Note:** EQ-5D, SF-36, SF-12, SF-6D, HUI-2 and HUI-3 are generic preference-based measures, TTO and SG are direct elicitation methods; ARMD: age-related macular degeneration; IQR: interquartile range; MCS: mental component score; PCS: physical component score; SD: standard deviation; SE: standard error; h: Frick et al. and Sugar et al. were merged with this study
Appendix L. Results of the Associations Between Predictor Variables

**Pearson correlation coefficients for the associations between continuous predictor variables.**

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<th>Number of Ocular Comorbidities</th>
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**Chi-square tests (p-value) for the associations between categorical predictor variables.**

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<th>Socioeconomic status during COVID-19</th>
<th>Use of a mobility aid</th>
<th>Retinal disease</th>
<th>Glaucoma</th>
<th>Cataracts</th>
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<td>0.941</td>
<td>0.718</td>
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<td>0.801</td>
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Results of associations between continuous and categorical predictor variables.

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<td>0.319</td>
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### Use of a mobility aid

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### Glaucoma

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### Cataracts

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**Appendix M. Results of the Validation of Backwards Stepwise Linear Regression Models**

1. 25-item National Eye Institute Visual Function Questionnaire model

Linearity:
Constant variance of residuals:

![Chart showing constant variance of residuals]

Normality of residuals:

![Chart showing normality of residuals]

Multicollinearity:

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</tr>
<tr>
<td>ret3</td>
<td>1.00</td>
<td>0.996346</td>
</tr>
</tbody>
</table>

| Mean VIF | 1.00 |

2. Center for Epidemiological Studies-Depression

Constant variance of residuals:
Normality of residuals:

Multicollinearity:

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<th>Variable</th>
<th>VIF</th>
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| Mean VIF | 1.04 |

3. Hospital Anxiety and Depression Scale – Anxiety subscale

Constant variance of residuals:
4. Pittsburgh Sleep Quality Index

Constant variance of residuals:
Normality of residuals:

5. Community Integration Questionnaire

Linearity:

Constant variance of residuals:
Normality of residuals:

Multicollinearity:

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<tr>
<td>Mean VIF</td>
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**Appendix N.** Backwards linear regression model assessments from leave-one-out cross validation.

<table>
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<tr>
<th>Model outcome</th>
<th>Root Mean Square Error</th>
<th>Mean Absolute Error</th>
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<td>NEI VFQ-25</td>
<td>10.98</td>
<td>8.98</td>
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<td>CES-D</td>
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<td>HADS-A</td>
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<td>CIQ</td>
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</table>
Curriculum Vitae

Name: Brian E. Yu

Post-Secondary Education and Degrees:

Western University
London, Ontario, Canada
2021-2022 MSc. Epidemiology & Biostatistics

Western University
London, Ontario, Canada
2017-2021 BMSc. (Honours)

Honours and Awards:

Department of Epidemiology & Biostatistics 2021 – 2022 Western Graduate Research Scholarship

Canadian Institutes of Health Research (CIHR) 2021 – 2022 Canada Graduate Scholarships-Master's Award (CGSM)

Western Gold Medal 2021 Major in Physiology