Burden and Determinants of Blindness and Visual impairment Among the Elderly in the Dikgale Health and Demographic Surveillance System (HDSS), Capricorn District, Limpopo Province, South Africa.

By

Mologadi Dimakatso Ntsoane

THESIS Submitted in fulfilment of the requirements for the degree of

PhD

in

Medical Sciences

in the

FACULTY OF HEALTH SCIENCES
(School of Health Sciences)

at the

UNIVERSITY OF LIMPOPO

Supervisor: PROF M.ALBERTS
Co-Supervisors: PROF JP van GEERTRUYDEN
PROF SD MATHEBULA

2016

DECLARATION

I declare that the thesis hereby submitted to the University of Limpopo, for the degree of PhD (Medical Sciences) has not previously been submitted by me for a degree at this or any other university; that it is my own work in design and execution, and that all material contained herein has been duly acknowledged.

_____ _____

NTSOANE M.D (MS) **Date**

DEDICATION

This thesis is dedicated to my three lovely children (my daughters, Tumelo Shatadi and Tshegofatṡo Pheladi and son Moeketsi Katlego Kuaho), and husband Theko for their unconditional love, patience, encouragement, and support during the study period.

ACKNOWLEDGEMENTS

I would like to convey my greatest gratitude to the following people:

My parents: My beloved father, Raymond Tshwaedi Ntsoane and beloved mom, Ramathabatha Merriam Ntsoane, for having been there for me when I needed them most.

My siblings: Ms Ramokoena Adelaide Phatlane, Ms Raesibe Emily Maluleke, Mr Chueuekgolo Joseph Ntsoane and Monchu David Ntsoane who have been my pillars of strength.

My Supervisor, Professor Marianne Alberts, for your guidance, support and encouragement.

My co-supervisor, Prof Solani David Mathebula,ñthank you very much for your inspiration, encouragement, and selfless adviceò

Mr Darikwa T, Mr Monyai S: Thank you very much for your assistance with data analysis.

All the people who participated in the study, it was through you that this study was possible.

Mr Scholtz A, thanks very much for assistance with editing.

The University of Limpopo Turfloop Campus, for accommodating me as one of their PhD students.

Above all, To God Almighty, Jehovah Jireh, You are the Lord, my provider
(Psalm: 24).

TABLE OF CONTENTS

DEFINITIONS OF TERMS

Age-related macular degeneration: Deterioration of the macula that results in a loss of sharp central vision (Grosvenor, 2007).

Amblyopia: A condition in which lowered visual acuity exists, even with the best corrective lenses, without obvious cause (Grosvenor, 2007).

Apartheid: The government policy of racial segregation (formerly in South Africa); officially renounced in 1992 (Pearsall, 1999).

Blindness: Visual acuity of less than 3/60 or visual field loss of less than 10 degrees in the better eye with best possible correction (World Health Organization, 2011). **Total blindness** is the complete lack of form and visual light perception and is clinically recorded as no light perception (NLP).

Burden of blindness: Magnitude, impact and distribution of blindness in a community (Oriahi, 2009).

Cataracts: Clouding of the crystalline lens of the eye which impedes the passage of light and may prevent a clear image from forming on the retina (World Health Organization, 2009).

Determinants: Any attribute, characteristic or exposure of an individual that increases the likelihood of developing a diseases or suffering an injury. This includes both the aetiology and risk factors (Oriahi, 2009).

Diabetic retinopathy: Microangiopathy affecting the retinal precapillary arterioles, capillaries and venules, with features of both microvascular occlusion and leakage that arrises from complication of diabetes (Kanski, 1989).

Epidemiology: The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems (Saunders, 2001).

Fundus (eye): Anatomical term referring to the interior posterior lining of the eye that includes the retina, optic nerve head or disc, and macula area. The fundus can be viewed or photographed with an ophthalmoscope or fundus camera, respectively. The fundus of the eye is the only part of the body where the microcirculation can be observed directly (Crick and Khaw, 2003).

Glaucoma: An ocular disease characterised by increased intraocular pressure that causes damage to the optic nerve fibers entering the optic nerve, leading to loss of vision (Grosvenor, 2007).

Hyperopia: Farsightedness (or the ability to see far objects more clearly than near objects), is a refractive error defect of the eye in which image is focused at the back of the eye. Hyperopia may be corrected with spectacle lenses or contact lenses with plus power (Grosvenor, 2007).

Hypertensive retinopathy: Complication of all types of hypertension that compromises the retina with features of both macrovascular occlusion and leakage (Grosvenor, 2007).

Low Vision: Visual acuity of less than 6/18, but equal to or better than 3/60, or a corresponding visual field loss between 20 and 10 degrees in the better eye with best possible correction (World Health Organization, 2011).

Myopia: Nearsightedness (or the ability to see close objects more clearly than distant objects), is a refractive error defect of the eye in which image is focused in front of the eye. Myopia may be corrected with spectacle lenses or contact lenses with minus power (Grosvenor, 2007).

Open angle glaucoma: Slowly progressive form of glaucoma in which the anterior chamber angle remains open, apparently due to a decreased out flow of aqueos through the trabecular meshwork (Grosvenor, 2007).

Ophthalmology: A branch of medicine concerned with the anatomy, physiology and diseases of the eye (Saunders, 2001).

Optometric services: Services rendered by a qualified optometrist to examine eyes which includes refraction and dispensing, the detection/diagnosis and management of diseases in the eye and the rehabilitation of the visual system (Millodot, 2009).

Optometrist: A primary healthcare practitioner of the eye and visual system who provide comprehensive eye and vision care, which includes refraction and dispensing, the detection/diagnosis and management of diseases in the eye and the rehabilitation of the visual system (Millodot, 2009).

Optic nerve: Exit site for all retinal nerve fibres that contains a bundle of over 1 million nerve fibers that carry visual messages from the retina to the brain (Kanski, 1989).

Prevalence: The total number of all cases of a specific disease present in a given population at a certain time. Prevalence is expressed as a ratio in which the number of cases is the numerator and the population at risk is the denominator (Saunders, 2001).

Pupillary dilatation: Process by which the pupil is temporarily enlarged with special eye drops, allowing an eye care practitioner to view the fundus better (Grosvenor, 2007).

Refractive error: Occurs in the eye when accommodation is relaxed, and parallel rays of light fail to converge to a sharp focus on the retina. Categories

of refractive error include short-sightedness, long sightedness and astigmatism (Grosvenor, 2007).

Retina: The light-sensitive tissue that lines the inner surface the eye. The retina sends visual impulses through the optic nerve to the brain development, learning, communicating, working, health, and quality of life (Vision and Hearing, 2010).

Sear-D: Countries like Bangladesh, India, Nepal and Pakistan grouped together as World Health Organization subregions (Resnikoff et al. 2008).

Visual Acuity: The resolving power of the eye, or the ability to see two separate objects as separate. The normal eye can resolve two objects as separate (with adequate illumination and contrast) if they are separated by an angular distance (Grosvenor, 2007).

Presenting Visual Acuity: Visual acuity in the better eye using currently available refractive correction, if any (World Health Organization, 2009).

Corrected Visual Acuity: Visual acuity in the better eye achieved by subjects tested with a pinhole or refractor (World Health Organization, 2009).

Visual field: Entire area that can be seen when the eye is looking straight ahead, including peripheral vision (Grosvenor, 2007).

Visual impairment: Presenting visual acuity of less than 6/18 (moderate visual impairment) but >3/60 (severe visual impairment) in the better eye with best possible correction and or, visual field loss of less than 20 degrees (Resnikoff et al., 2008).

Vision 2020: The Right to Sight: is a global initiative established by the World Health Organization (WHO) and the International Agency for the prevention of

blindness, aimed at the elimination of avoidable blindness and impaired vision (World Health Organization, 2000).

LIST OF ABBREVIATIONS

ACG: Angle closure glaucoma

AIDS: Acquired immune deficiency syndrome

ARMD: Age-related macular degeneration

BP: Blood Pressure

CMV: Cytomegalovirus

CVF: Central visual field

DOH: Department of Health

FI: Fundus imaging

HDSS: Health and Demographic Surveillance System

HIV: Human immunedeficiency virus

ID: Identity

IOL: Intra ocular lens implant

LogMar: Logarithm of the minimum angle of resolution

MmHg: Millimeter of mercury

Mmol/L: Millimol per litre

MREC: Medical research ethics committee aproval

MSVI: Moderate/Severe Visual Impairment

NLP: No light perception

OR: Odds Ratio

PH: Pinhole

POAG: Primary Open Angle Glaucoma

SA: South Africa

UV: Ultraviolet

VI: Visual impairment

VA: Visual acuity

WHO: World Health Organization

WNL: Within Normal Limits

LIST OF TABLES

ABSTRACT

BACKGROUND

The burden of visual impairment is a major health problem worldwide, especially in the rural and remote areas of developing countries. Visual impairment does not only affect the productivity of the individuals affected, but may also result in a loss of income for those caring for them, which is time consuming. Globally, the majority of instances of visual impairment can be avoided or treated, if detected early. Therefore, it was considered important to evaluate the burden and determinants of blindness and visual impairment in order to institute measures to prevent avoidable blindness.

AIM OF THE STUDY

The aim of this study was to investigate the burden and determinants of blindness and visual impairment among the elderly in the Dikgale Health and Demographic Surveillance System (HDSS), Capricorn District, Limpopo Province, South Africa.

METHODOLOGY

A cross-sectional analytic and descriptive study design was used. The participants included males and females, 50 years and above, who were permanent residents in the Dikgale HDSS. Optometric procedures were performed and a questionnaire was administered to the people selected as study participants to collect data about the knowledge, need, utilisation of eye-care services and barriers to the use of eye-care services in the area. Optometric procedures performed included case history, presenting visual acuity, pin-hole visual acuity if the presenting visual acuity was less than 6/18, auto and subjective refraction, visual fields using a Novissphere and Amslerôs grid, tonometry, direct ophthalmoscopy through a dilated pupil, and light perception for cases of blindness.

Prevalence rates of blindness and visual impairment were determined by the results obtained from the oculo-visual examinations, such as visual acuity

measurements. Data analysis was done using the Statistical Package for Social Sciences (SPSS) Version 23. Overall prevalence was calculated, as well as prevalence within subgroups defined by gender. To determine the predictive values for the determinants of visual impairment, the Pearsonôs Chi square (with a 0.05 significant level) was used in order to eliminate the possibility that the observed results happened by chance.

The odds ratios were calculated and interpreted at a 95% confidence interval to determine the strength of association between visual impairment and risk factors. Binary and multinomial logistic regression analyses were used to describe the relationship between visual impairment and demographics, socioeconomic factors, ocular risk factors and chronic diseases. All reported *p*-values which were two-sided and *p*-values <0.05 were considered significant. Results are presented in narrative and tabular forms and as figures. The study used descriptive analytical methods to describe the outcome of the research.

RESULTS

Of the 1000 selected subjects for the study, a total of 704 participated (i.e. completed the questionnaire and had the clinical tests performed on them), in other words, a response rate of 70.4%. The participants included 508 females and 196 males. All participants were Black South Africans and their ages ranged from 50 to 105 years, with a mean age of 65.6±10.3. The prevalence of bilateral visual impairment meeting the criteria in the better eye was 26.4% (186) of the 704 observed respondents. The majority of the participants had moderate visual impairment, with a similar prevalence in males and females. Many participants used tobacco products (278 or 39.4%). Cataracts (46.2%) and refractive error (40.3%) continue to be the leading causes of visual impairment, followed by corneal disorders (4.9%) and glaucoma (4.3%). The prevalence of low vision increased with age ($p<0.001$), but there was no significant difference between females (62.0) and males (58.5).

The odds ratio of having visual impairment increased significantly with age ranging from OR 1.2 (95% CI, 0.6-2.3) in the age group 60-69 to OR 3.8

(95%CI, 1.6-9.0) in the age group 80+. The likelihood of having visual impairment increased with tobacco use OR 1.9 (95%CI, 1.1-3.3). Not using available eye-care services increased the risk of having visual impairment OR 1.3 (95%CI, 0.8-2.2). Refractive error and pathological disorders were significantly associated with all the different degrees of visual impairment. Tobacco use was only significantly associated with moderate visual impairment and not significantly associated with severe visual impairment. Unemployment and lack of education are likely to increase the burden of visual impairment among the participants when looking at p-values for trends.

CONCLUSION

There is a high prevalence of presenting visual impairment in the 50+ age group in the Dikgale HDSS. Most of the leading causes of visual impairment are preventable and/or treatable, which can be achieved by appropriate screening strategies. Therefore, there is a need to embark on eye care promotion and awareness campaigns; and to provide low-cost, quality spectacles and cataract surgeries. Better education about prevention of blindness and visual impairment will help to minimise this burden.

CHAPTER 1

1.1 INTRODUCTION AND BACKGROUND

Of the five senses, humans depend predominantly on vision to provide the primary cues for conducting basic activities. Vision is an essential part of everyday life and affects development, learning, communication, working, health and quality of life (Resnikoff et al., 2008). Worldwide, visual impairment (VI) is also considered as one of the most feared disabilities that a person can suffer (Awan et al., 2011; Mabaso, 2012). According to the World Health Organisation (2011), blindness does not only mean complete loss of vision, but also includes the inability to see properly from a distance of three meters and, therefore, not being able to manage day-to-day activities independently. Partial and total blindness can cause psychological and social isolation (Whitfield et al., 1990) and can be a tremendous economic burden, reducing quality of life (Isipraditt et al., 2014). The presence of high rates of blindness in a community implies a significant loss of productivity within the community, not only because the blind person cannot be productively engaged, but also because others must care for them and help generate resources for their survival (Whitfield et al., 1990).

Visual impairment due to ocular diseases is still a major public health issue that is unequally distributed among countries (Pascolini and Mariotti, 2012) Visual impairment is widely acknowledged to have both demographic and socioeconomic determinants (Cockburn et al., 2012). There is a positive association between visual impairment and poverty (Stevens et al., 2013). Furthermore, visual impairment affects economic and educational opportunities, reduces the quality of life and increases the risk of death (Stevens et al., 2013). Resnikoff et al. (2008), stated that visual impairment is defined as presenting visual acuity of less than 6/18 (moderate visual impairment) but >3/60 (severe visual impairment) in the better eye with best possible correction and or visual field loss of less than 20 degrees. Blindness is defined as visual acuity of less than 3/60 or visual field loss of less than 10 degrees in the better eye with best possible correction (World Health

Organisation, 2011). Total blindness is the complete lack of form- and visual light-perception and is clinically recorded as no light perception (World Health Organisation, 2011).

Globally there are approximately 285 million people who are visually impaired, of which 39 million are blind and 246 million have low vision (Pascolini and Mariotti, 2012) and its burden is not uniformly distributed (Resnikoff et al., 2008). That is, the least developed regions of the world carry the largest share when compared to the developed world. In support of Resnikoff et al. (2008), Jonas et al. (2013) stated that prevalence of blindness in developing countries is four times and Tabbara (2001) stated that it is 10-40 times higher in developing countries than in developed countries, with the majority of blind people residing in the developing nations of Africa, Asia and Latin America. Pascolini and Mariotti (2012) also stated that 90% of visually impaired people live in the developing countries. However, the burden of visual impairment is also high in developed countries (Pascolini and Mariotti, 2012).

Visual impairment is unevenly distributed across age groups, i.e. 82 % of all blind people are 50 years of age or older and more than 90% of the worldôs visually impaired people live in developing countries (World Health Organisation, 2013). Kyari et al. (2009) are in agreement with the above studies, stating that there is a high prevalence of visual impairment, blindness and severe visual impairment among those aged 40 years and above in Nigeria. Cook et al. (1993) further stated that there is a considerable resistance to medical intervention amongst the elderly in communities with low literacy levels, which needs to be investigated. With respect to gender, females in every region of the world and of all age groups have a significantly higher risk of being visually impaired (World Health Organisation, 2007). In sub Saharan Africa, Naidoo et al. (2014) reported that women bear a greater burden of visual impairment, including blindness, than do men. Other risk factors include tobacco use, exposure to ultraviolet (UV) radiation, vitamin A deficiency, acquired immune deficiency syndrome (AIDS), high body mass index and metabolic disorders (World Health Organisation, 2007).

The few available publications available in South Africa reported that the prevalence of blindness in adults is 0.75% (Department of Health Directorate, 2002) and that 80 % of this blindness is avoidable, i.e., either treatable or preventable by simple and inexpensive means (Sacharowitz, 2005). In studies done in South Africa, the prevalence of blindness in adults was found to be 1.4% (95%CI 0.9-1.8) in Cape Town (Cockburn et al., 2012), 0.57% in the former Gazankulu Homeland (Bucher & Ijsselmuiden, 1988), 1.0% in northern Kwazulu Natal (Cook et al., 1993) and 0.24% in the rural Limpopo Province (Oduntan et al., 2003). The low prevalence of blindness in the Oduntan et al (2013) study could have been due to the fact that the study population included the younger participants. Cataract was identified as one of the major causes of blindness and visual impairment in South Africa. According to Oduntan et al. (2003) in a study of low vision and blindness in black South African adults, cataracts constituted 47.06% of visual impairment, and both Bucher & Ijsselmuiden (1988) and Cook et al. (1993) reported 59% of blindness in their studies.

Globally, major risk factors of visual impairment include both non-ocular factors, such as age, gender and socioeconomic status and ocular risk factors, such as retinopathies, macular degenerations, glaucoma and refractive error (World Health Organisation, 2013). Other risk factors include tobacco use, exposure to ultraviolet (UV) radiation, vitamin A deficiency, high body mass index, metabolic disorders, environmental factor, poverty and lifestyle (World Health Organisation, 2013). Cataracts was previously identified as one of the major causes of blindness and visual impairment in South Africa in three studies (Bucher & Ijsselmuiden, 1988; Oduntan et al., 2003; Cook et al., 1993), but with the development of a high chronic disease burden in the country at present (Alberts et al., 2005), the burden and determinants of blindness needs to be investigated in the Limpopo Province of South Africa.

Preventable blindness due to ocular diseases is considered as one of the most tragic, wasteful and significant public health problems globally (Furtado et al., 2012). Approximately 80% of the people who are blind in the developing

world suffer from conditions which are avoidable, in the sense that their blindness could have been prevented or surgically corrected (World Health Organisation, 2013). Uncorrected refractive error, cataracts, glaucoma and diabetic retinopathy are the leading causes of avoidable blindness and visual impairment in the world. Globally, close to 51% of blindness and visual impairment is due to un-operated cataracts; while other important causes include glaucoma, diabetic retinopathy, and childhood blindness (Pascolini and Mariotti, 2012).

Furthermore, other common causes of blindness worldwide, especially in the developing countries, include genetic conditions (congenital cataracts, glaucoma and albinism), environmental factors (such as a dry, dusty environment), systemic and visual pathway diseases (such as diabetes and hypertension) and poverty and lifestyle factors, like smoking (Oduntan, 2005). According to the World Health Organisation (2007), major risk factors for visual impairment include non-ocular risk factors, such as age, gender, and socioeconomic status and ocular risk factors, such as retinopathies, macular degenerations, glaucoma, refractive error and others. Further, Lewallen and Courtright (2001) stated that the major causes of blindness in developing countries can be classified as: (1) those which occur universally and for which there are successful treatments; (2) major blinding diseases that are less well defined and for which cost effective screening and treatment do not currently exist; and (3) those which occur within specific populations and which can be prevented using inexpensive medicines.

According to World Health Organisation (2008), visual impairment and its resulting disability are among the more serious consequences of non communicable diseases in Africa. Visual impairment does not only affect productivity of the individuals affected, but also causes loss of income and has time implications for those caring for them (Kyari et al., (2009). However, the public health challenge is that if eye problems were detected early, much of the blindness and visual impairment could be reversible and even preventable with currently available ophthalmic treatments (Owsley et al., 2006). Keeffe et al. (2002) are in agreement with the above statement, stating

that the high percentage of undiagnosed eye disease and visual impairment, including glaucoma, diabetic retinopathy and under corrected refractive error indicates a need for improved access to, and greater utilisation of, existing eye-care services. Further, Ashaye et al. (2006) stated that health education intervention should be designed specifically to increase awareness of asymptomatic diseases in order to detect them in the early stages so as to prevent avoidable blindness. Therefore, knowing the burden and determinants of blindness and visual impairment will help to establish possible preventative measures in order to prevent avoidable blindness.

Generally all over the world the main causes of visual impairment do not differ between countries, but differ in their prevalence and in the type of impairment (Ali and Klalil, 2011).The magnitude of blinding eye conditions and the efforts needed to prevent them can only be appreciated if there are sufficient data indicating the causes and prevalence of the conditions in the various communities or regions (Oduntan et al., 2003). Therefore, there is a need for at least a five year blindness survey in order to gather the required data (World Health Organisation, 2011). Blindness, like any other health condition, can be prevented if its causes are identified, detected and managed timeously (Oduntan et al., 2003). One of the limitations of the study done by Oduntan et al. (2003) was the fact that the researchers were not able to do pupillary dilations or fundus camera imaging in order to investigate the causes of blindness in full, due to the lack of diagnostic rights for optometrists. Optometrists in South Africa now have diagnostic rights and, therefore, that limitation has been eliminated and the present study was able to reveal the major causes of blindness and visual impairment.

Reskinoff et al. (2008), states that there is still a paucity of national data regarding blindness and visual impairment in Africa. South Africa, despite being one of the economic giants in Africa, does not have a national estimate on the prevalence and causes of blindness and visual impairment. Thus, not enough up to date information is available regarding the prevalence and causes of blindness and visual impairment in rural populations. Therefore, studying the burden and determinants of blindness and visual impairment in

this rural setting will help to close the gaps in this regard in South Africa and will help to generate possible preventative measures in order to prevent avoidable blindness and the achievement of the goals of Vision 2020 blindness prevention programmes in South Africa.

1.2 RESEARCH PROBLEM

In South Africa, research on the epidemiology of blindness and visual impairment has not been extensive enough, particularly in the Limpopo Province. A few studies have been undertaken on the prevalence and causes of blindness and visual impairment or their risk factors in the Dikgale Health and Demographic Surveillance System (HDSS) site, but these studies are more than 10 years old. Anecdotal observations at an old peoplesô home in the Dikgale HDSS indicated concerns for the presence of avoidable blindness, which need to be investigated.

The present study was designed to address the burden and determinants of blindness and other forms of visual impairment and to establish possible blindness prevention measures in the in a rural setting of the Dikgale HDSS, Limpopo Province, South Africa. This research study was supported by the fact that scientific knowledge on the burden and determinants of blindness and visual impairment is critical for the prevention of blindness, which is one of the five priorities of Vision 2020: The Right to Sight, the World Health Organisationôs Global Initiative for the Elimination of Avoidable Blindness

1.3 PURPOSE OF THE STUDY

1.3.1 Aim of the study

The aim of this study was to investigate the burden and determinants of blindness and visual impairment amongst the elderly in the Dikgale HDSS, Capricorn District, Limpopo Province, South Africa.

1.3.2 Objectives of the study

- ŏ To determine the prevalence, distribution, and extent of visual impairment and blindness amongst the elderly in the Dikgale HDSS.
- ŏ To determine the prevalence of ocular disorders such as cataracts, retinopathies, glaucoma, uncorrected refractive errors, age related macular degeneration (ARMD) and low vision amongst the elderly in the Dikgale HDSS.
- ŏ To identify the determinants of blindness and visual impairment amongst the elderly in the Dikgale HDSS.
- ŏ To determine the relationship patterns between systemic conditions, such as diabetes and hypertension; distribution, in terms of age, gender and other parameters; and the extent of visual impairment amongst the elderly in the Dikgale HDSS.
- ŏ To assess the level of knowledge of the elderly people in the Dikgale HDSS regarding eye care services available to them.
- ŏ To assess the level of eye-care serviced utilisation by the elderly in the Dikgale HDSS.
- ŏ To determine the relationship patterns between knowledge, need and use of eye care services and the extent of visual impairement and blindness.

1.4 HYPOTHESIS

A high burden of blindness and visual impairment is present amongst the elderly, from 50 years and older, in the Dikgale HDSS, Limpopo Province of South Africa.

1.5 RESEARCH QUESTIONS

- ŏ What is the prevalence and distribution of blindness and visual impairment amongst the elderly in the Dikgale HDSS?
- ŏ What is the prevalence of ocular disorders such as cataracts, retinopathies, glaucoma, uncorrected refractive errors, age related

macular degeneration (ARMD) and low vision amongst the elderly in the Dikgale HDSS?

- What are the determinants of blindness and visual impairment amongst the elderly in the Dikgale HDSS?
- What is the relationship pattern between systemic conditions (such as diabetes, hypertension, and rheumatism) and the distribution (in terms of age, gender etc.) of visual impairment amongst the elderly in the Dikgale HDSS?
- What is the level of knowledge of elderly people in the Dikgale HDSS regarding eye care services available to them?
- What is the level of eye-care service utilisation by the elderly in the Dikgale HDSS?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

In the previous chapter an overview, background and definition of visual impairment and blindness were discussed. The research problem, purpose of the study, research questions and hypothesis were also stated. In the present chapter the literature will be reviewed in detail.

Traditionally, the World Health Organisation (2003), in its International Statistical Classification of Diseases, injuries and Causes of Death (10^{th} revision (ICD-10), H54), has always defined the measure of visual impairment as visual acuity with the best possible refractive error correction. However, according to Resnikoff et al. (2008), the above definition does not embrace visual impairment due to refractive error, even though it was recognised world wide that uncorrected refractive error could lead to impaired quality of life and contribute significantly to low vision and blindness. Therefore, Resnikoff et al. (2008), defined visual impairment as presenting visual acuity of less than 6/18 (moderate visual impairment) but >3/60 (severe visual impairment) in the better eye with best possible correction and or visual field loss of less than 20 degrees around the central vision with presenting correction in order to include refractive errors. However, recent surveys by Budenz et al. (2012) in the United States of America and Kyari et al. (2009) in Nigeria, found that visual impairment as defined by Resnikoff et al. (2008) does not include mild visual impairment. Therefore, recent studies have added the lowest presenting visual acuity category of less than 6/12 (mild visual impairment), as suggested by Dandona and Dandona (2006) in their revision of visual impairment definitions in the International Statistical Classification of Dieases.

2.2 OVERVIEW OF BURDEN OF VISUAL IMPAIRMENT AND BLINDNESS

According to the World Health Organisation's VISION 2020: The Right to Sight: A global initiative to eliminate avoidable blindness, it has been estimated that every five seconds one person goes blind and that in 2004 there were an estimated 40-45 million blind people worldwide, mainly in low income countries. Furthermore, it is projected that this figure will reach 76 million in the year 2020, if nothing is done about the problem. According to Pascolini and Mariotti (2012), currently there are an estimated 39 million blind people globally, 32 million of which are 50 years and above, 246 million present with low vision (146 million 50 years and above), and 285 million are visually impaired (186 million 50 years and above). In the United States of America, which is one of the developed countries of the world, it was reported that an estimated 80 million people have potentially blinding eye diseases, 3 million have low vision, 1.1 million people are legally blind and 200,000 are more severely visually impaired (Pascolini and Mariotti, 2012).

With respect to the developing countries of the world, Schellini et al. (2009) reported a 2.2% prevalence of blindness in a study undertaken on the Brazilian population. Salamão et al. (2008) reported a prevalence of visual impairment of 4.74% amongst the older adults in Brazil. The 2.5% difference in the prevalence of visual impairment in the Brazilian population between these two studies could be due to the fact that Salamão et al. (2008) undertook their study amongst the older population of the country, who are more prone to develop visual impairment than are the younger population group. Studies by Schellini et al. (2009) and Ramke et al. (2007) found the prevalence of blindness to be 4.1%, amongst people 40 years and above in Brazil and Timor-Leste respectively. Garap et al. (2006) reported the prevalence of blindness at 8.9% amongst the elderly in Papua New Guinea. In African countries, Abdull et al. (2009) and Budenz et al. (2012) found the prevalence of visual impairment and blindness amongst people of 40 years and older to be 8.4% and 17.1% in Nigeria and Ghana respectively, indicating that most of these conditions were curable or could be corrected.

In sub-Saharan Africa, Naidoo et al. (2014) reported an age standardised prevalence of blindness of 1.3% for the region, with moderate/severe visual impairment (MSVI) prevalence of 4.0%, in 2010. In South Africa the prevalence of blindness in adults is 0.75% (Department of Health Directorate, 2002) and 80% of this blindness is avoidable (i.e. either treatable or preventable) by simple and inexpensive means (Sacharowitz, 2005). In a study done in Northern KwaZulu-Natal, Cook et al. (1993) found the prevalence of blindness to be 1%. In urban Cape Town, South Africa, a similar prevalence of blindness (1.4%) was reported (Cockburn et al., 2012). In the former Transvaal, Gazankulu area, now included in the Limpopo Province, the prevalence of blindness in adults was found to be 0.57% (Bucher & Ijsselmuiden, 1988), whereas Oduntan et al. (2003) found the prevalence of blindness amongst adults in the Limpopo Province of South Africa to be 0.24%. The low prevalence of blindness and visual impairment in South Africa could have been due to the fact that visual impairment due to refractive errors was not taken into consideration.

In older population-based studies, the methodology for measuring visual acuity in order to categorise it was to perform pinhole visual acuity to determine the best corrected vision (Pararajasegaram, 2004; Thylefors et al., 1995). That is, visual function was assessed by measuring the corrected distance visual acuity using Snellenôs chart with optimal contrast in the better eye and sometimes the data was supplemented with visual fields (Seland et al., 2011). Pinhole visual acuity was done following the universally accepted criteria for visual impairment determination set by World Health Organisationôs 10th Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10), which stated that visual impairment consisted of best corrected visual acuity of less than 6/18/logMAR>0.48. This means that these results were recorded using logMAR based test charts, due to their accuracy and efficiency (Ali and Klalil, 2011; Seland et al., 2011).

According to the World Health Organisation (2011), many recent studies have shown that the use of best corrected vision overlooks a large proportion of

persons with visual impairment, without taking into account the effect of uncorrected refractive error as the cause of visual impairment. These results did not include blindness due to uncorrected refractive errors, though this is a common occurrence in the world (World Health Organisation, 2011). Therefore, current studies use uncorrected visual acuity of less than 6/18/logMAR>0.48 in order to accommodate unnecessary visual impairment due to refractive error (World Health Organisation, 2011). Uncorrected error is a cost effective way of determining visual acuity and its utilisation is one of the priorities under the disease control component of the Global Elimination of Avoidable Blindness (Vision 2020, the Right to Sight) (World Health Organisation, 2011). Therefore, the current trend for measuring the prevalence of visual impairment is to use the categories defined by the World Health Organisationôs categories of visual impairment (World Health Organisation, 2011).

2.3 DETERMINANTS OF BLINDNESS AND VISUAL IMPAIRMENT

According to Oriahi (2009), the determinants of blindness include both aetiology and risk factors. The World Health Organisation (2007), defines a risk factor as any attribute, characteristic or an exposure of a hazard of an individual that increases the likelihood of developing a diseases or suffering an injury, even though a large proportion (18%) of these risk factors go undetermined (World Health Organisation, 2007). According to Pascolini and Mariotti (2012), preventable causes of visual impairment are as high as 80% of the global burden. A study done by Mathenge et al. (2007) in Nakuru district of Kenya, found that definite avoidable causes of blindness, such as cataracts, refractive error, trachoma and corneal scarring, contributed 74.9% to bilateral visual impairment and 69.6% to bilateral blindness. Furthermore, Chipendo et al. (2012) reported that 80% of the causes of blindness amongst the blind population of Zimbabwe were avoidable. Early diagnosis and timely treatment have been shown to prevent vision loss in more than 90% of patients with potentially blinding eye problems (World Health Organisation, 2009). Therefore, health care practice guidelines recommend an annual

dilated eye examination for all people with diseases such as diabetes (World Health Organisation, 2009).

Furthermore, Pascolini and Mariotti (2012) report that posterior segment (retinal) diseases are the major cause of visual impairment worldwide and are likely to become increasingly important with the rapid growth of the ageing population. That is, the proportion of visual impairment and blindness from age-related macular degeneration, glaucoma and diabetic retinopathy is currently greater from infectious causes, such as trachoma and corneal opacities. This might be due to the fact that many people with diseases such as diabetes do not undergo an annual dilated eye examination (World Health Organisation, 2009) and, therefore, an estimated 50% of patients are diagnosed too late for treatment to be effective. That is, in order to prevent avoidable blindness, eye care promotions and awareness should be investigated intensively and the implications of delayed eye care must be emphasised (Ntsoane and Oduntan, 2010). In support of the idea of eye care awareness and promotion, the World Health Organisation (2013) states that, globally, there has been a decrease in the prevalence of visual impairment since the early 90s, despite an ageing population. This decrease has been noted to be due to concerted public health action, increased availability of eye care services and a general awareness amongst the population of solutions to the visual impairment problems (World Health Organisation, 2013).

2.3.1 Non ocular risk factors of blindness and visual impairment

2.3.1.1 Age

The risk of visual impairment and blindness increases significantly with increasing age (Fotouhi et al., 2006; Ramke et al., 2007; Budenz et al., 2012). That is, the majority of people with visual impairment and blindness are the elderly (World Health Organisation, 2011) and there is an increase in number of impaired visual function with increasing age (Isipraditt et al., 2014; Budenz et al., 2012; Seland et al., 2011). In support of the above phenomenon, Resnikoff et al. (2008) and Stevens et al. (2013) reported that visual impairment was uniquely distributed across age groups, and that it is more

common amongst adults 50 years of age and older. The World Health Organisation (2009), stated that globally the number of people who are blind from refractive errors was 5.13 times higher in the age groups 50 and older than in those who are 49 years old and younger. Stevens et al. (2013) are in agreement with the World Health Organisation (2009). In a study on global trends of vision impairment and blindness they also indicated that the number of people with visual impairment and blindness increased by 0.6 percent to 5.3 million between the year 2000 and 2010, due to the fact that the global population has increased and aged remarkably. Leasher et al. (2014) also reported that moderate/severe visual impairment continued to rise with age, between the years 2000 and 2010 with many countries showing tripple the age-standardised prevalence of moderate/severe visual impairment in ages 50 years and older when compared with other age groups.

In a study of prevalence and causes of low vision and blindness in the Tehran Province, Iran, Soori et al. (2011) reported that the prevalence of low vision increased with age, showing a significant positive correlation ($p<0.001$). In a study of the prevalence of blindness and visual impairment in Nigeria, Kyari et al. (2009) reported that visual impairment was highly prevalent amongst the older age groups. In South Africa, Mabaso and Oduntan (2014) reported a positive association ($p=0.02$) between increasing age and visual impairment, which could be due to eye diseases that are more prevalent in the aged than they are in the younger ones. In support of the above studies, Oduntan et al. (2003) also reported that ocular disorders increase significantly with age. Jonas et al. (2014) and Cook et al. (1993) also reported that the prevalence of blindness and low vision rose rapidly in those 50 years and older, with women being more affected than men. According to Seland et al. (2011), this considerable range of prevalence reported is attributed to a wide variation of causes of blindness and reflects a combination of demography, cultural traditions and presence of eye pathology combined with environmental and genetic factors; as well as the availability and quality of eye-care health services.

2.3.1.2 Gender

According to Cook et al. (1993) and the World Health Organisation (2011), the risk of visual impairment and blindness is higher in females than males in every region of the world and at all ages. Jonas et al. (2014) and Stevens et al. (2013) agreed with this statement in studies on global trends, reporting that women had a markedly higher prevalence of blindness and moderate visual impairment than did men. Furthermore, even when controlling for age, the prevalence of blindness amongst women was still greater than amongst men in all the regions of the world (Stevens et al., 2013). Resnikoff et al. (2008) and Shahrairi et al. (2007) also reported that females have a significantly higher risk of developing visual impairment and blindness than do males. Ashaye et al. (2009) in a study undertaken in Nigeria, reported that females were more at risk of developing eye diseases than were males. In sub Saharan Africa, Naidoo et al. (2014) also reported that there is a high prevalence of moderate/severe visual impairment in women (8.1%) than in men (7.3%) among those individuals 50 years and above. In contrast with the above statements, Soori et al. (2011) reported that there was no significant difference in visual impairment by gender, but that the prevalence of low vision was higher among females, with an odds ratio of 1.42 (95%CI, 1.16-1.74). While Isipraditt et al. (2014) reported that women had a similar prevalence of blindness but a higher prevalence of visual impairment when compared to men.

In South Africa, Mabaso and Oduntan (2014), in a study on risk factors for visual impairment and blindness amongst black adult diabetic subjects, also reported that the prevalence of visual impairment was higher in females than in males, but that gender (p= 0.79) was not statistically significant indicator of visual impairment. Furthermore, Oduntan et al. (2003) and Bucher & Ijsselmuiden, (1988) found that prevalence of blindness due to cataracts was more common in females than in males, but blindness due to ocular trauma was more common in males than in females. Stevens et al. (2013) agreed with the findings of Oduntan et al. (2003) and Bucher and Ijsselmuiden (1998), also reporting that gender disparity was lowest in the Sub-Saharan

African regions, with blindness occurring in women approximately 1.12 times more than in men. Cockburn et al. (2012) reported that there is a positive association between being female and risk of vision loss (Odds Ratio 1.4, 95%CI 1.1-1.9). Contrary to findings of the above researchers, Cook et al. (1993) and Chipendo et al. (2012) reported a higher prevalence of blindness, low vision and eye diseases in males than in females. This could have been due to the fact that in the study conducted by Chipendo et al. (2012), more females made use of the available eye-care services than men. Gilbert et al. (2008), in support of the above statement, stated that, in Pakistan, cataract surgical coverage was higher in men than in women.

2.3.1.3 Level of education

A study undertaken in Zimbabwe by Chipendo et al. (2012) found that educational level also affected the level of awareness of eye disease, as those who were not educated did not have knowledge of the various diseases. In South Africa, in a study undertaken by Mabaso and Oduntan (2014) found that the prevalence of visual impairment decreases significantly with an increase in level of education. Cockburn et al. (2012) reported an inverse assosciation between the prevalence of vision loss and increasing level of education (p-trend<0.001). Saw et al. (2003) also stated that educational level influenced glaucoma awareness levels. Robin et al. (2004), in a study done in India regarding the utilisation of eye-care services by persons with glaucoma, also found that the use of eye-care services increased with increasing education.

2.3.1.4 Occupation

According Chipendo et al. (2012), occupation was deemed a predisposing factor in developing eye disease due to non-use of protective eye wear. There was an association between occupation and the risk of eye diseases. This could have been due to the fact that the type of occupations undertaken by people in the study by Chipendo et al. (2012) required the participants to wear protective eye wear, which may not have been the case in other studies. Therefore, there was a perception that healthy eyes and good vision were the basis for survival in the work place.

*2.3.1.5 Socio economic status (*poverty and lifestyle)

According to Resnikoff et al. (2004) and Pascolini and Mariotti (2012), the prevalence of visual impairment and blindness is three- to four-fold higher in low income countries than in industrialised countries. Gilbert et al. (2008), in a study of poverty and blindness in Pakistan, reported that the prevalence of visual impairment and blindness was higher in poorer populations than in their affluent counterparts due to the inequality of access to eye-care services; and that some diseases like trachoma are known to be a result of poor hygiene and lack of sanitation in poverty stricken communities (Awan et al., 2011). The author further stated that, in Pakistan, poverty is significantly associated with blindness. Stevens et al. (2013) reported that the relative disparity in the prevalence of blindness was greatest in the high income regions, with more blind people in the lower economic regions. In contrast to the above, however, Jonas et al. (2014) stated that high income regions in USA/Western Europe still have a high prevalence of cataract blindness, but showed a significant disparity in ruralï urban prevalence. Awan et al. (2011) further stated that most of the visually impaired people live in developing countries, where basic health infrastructure is lacking and unable to meet the needs of the people (as the majority of people developing countries are plagued by poverty). In addition to the above finding, Nakamura et al. (2010) observed that the prevalence of visual impairment was 3 times higher in rural populations when compared to their urban counterparts. Pedro-Egbe and Babatunde (2010) also reported a high prevalence of avoidable blindness associated with poverty in African countries like Nigeria. In South Africa, Mabaso and Oduntan (2014) reported that low economic status was significantly associated with visual impairment.

2.3.1.6 Smoking

According to Solberg et al. (1998), the list of ocular diseases associated with smoking continues to grow and the leading causes of severe visual imparment and blindness are directly accelerated by smoking. Brenton et al. (2015) further stated that cigarette smoking is significantly associated with the development of eye diseases, such as uveitis OR 2.33 (95% CI, 1.22-4.45; p=0.001), cataracts (Solberg et al., 1998), and atherosclerosis (Billy et al.,

1996) due to the increased oxidative stress smoking causes to the tissues. Chipendo et al. (2012) indicated that smoking is one of the predisposing factors to the development of eye diseases and is significantly associated with visual impairment. Contrary to the above findings, Mabaso and Oduntan (2014) found that smoking was not statistically associated with visual impairment.

2.3.1.7 Systemic diseases

According to West (2013), the global increase in chronic diseases is mirrored in the shift in causes of blindness and visual loss, from anterior infectious to posterior chronic diseases of the eye, due to the manifestation of these chronic diseases inside the eye. Posterior segment diseases are considered one of the major causes of blindness worldwide among the elderly and are likely to become more and more important with the rapid growth of the ageing population (Pascolini and Mariotti, 2012). The study further stated that uncontrolled hypertension is one of the risk factors for developing hypertensive retinopathy. A study done by Alberts et al. (2005) on Black South Africans found that only 15% of women and 7% of men with hypertension used blood pressure medication, indicating that in the majority of hypertensive patients blood pressure was not controlled, predisposing them to hypertensive retinopathy.

In addition to the magnitude of blindness due to hypertension, the number of patients with type II diabetes is also increasing in developing countries and these patients have greater increased risk of developing retinopathy and, therefore, the identification of effective new strategies for the control of diabetes and its complications is a public health priority (van Dierren et al., 2010). In Iran, Soori et al. (2011) reported that 4.9% of cases of blindness due to diabetic retinopathy amongst the participants 25 to 64 years of age could have benefited by undergoing regular ophthalmic examinations. In South Africa, Mabaso and Oduntan (2014) reported that diabetic retinopathy may be significantly associated with visual impairment and blindness, but the development of diabetes was not significantly associated with the development of visual impairment. This is in contrast with the World Health

Organisation (2002), which stated that, as the incidence systemic diseases like diabetes gradually increases; there is the possibility that more individuals will suffer from eye complications which, if not properly managed, may lead to permanent eye damage. Therefore, this requires the urgent development of eye-care systems that address chronic eye diseases, in conjunction with rehabilitation, education and support services.

In addition to diabetes and hypertension, HIV/AIDS pandemic has taken its toll on the human race since it was first reported in 1981 with its common ocular complications and potential for visual impairment and ultimate blindness due to cytomegalovirus (CMV) retinitis (Kestelyn and Cunningham, 2001). Goldberg et al. (2005) in a review of HIV-associated retinopathy in the HAART era, stated that in the past patient living with HIV/AIDS especially in the developing countries were more prone to develop blindness at some point during the course of their illness due to CMV retinitis, but the positive effect of HAART to the immune system reduced the risk of blindness and low vision. Richard and Tebepah (2013) also in support of the above statement stated that the use of HAART in developing countries undoubtedly has a positive effect on the risk of blindness and low vision in those affected by HIV/AIDS.

2.3.1.8 Environmental factors

Environmental factors, such as temperature, rainfall, vegetations, humidity, topography and altitude, are associated with eye diseases, particularly those caused by infectious agents (Johnson, 2004). According to Resnikoff et al. (2004), in Africa, trachoma, which is endemic to dry, dusty environments, and onchocerciasis, which occurs mainly in communities close to rivers, still account for a significant proportion of blindness. The World Health Organisation (2009) also stated that corneal disorders encompass a wide variety of infectious and inflammatory eye diseases. Furthermore, significant corneal scarring can ultimately lead to functional vision loss. Globally, blindness resulting from corneal pathology accounts to 5.1% of total blindness and is rated as the fourth major cause of blindness (World Health Organisation, 2009), despite the fact that the available literature indicates that

South Africa is one of the developing countries that are currently trachoma free (Department of Health Directorate, 2002).

2.3.1.9 Health care facility use

According to Nakamura et al. (2010), most of the leading causes of visual impairment are treatable and could be decreased if accessibility to health care facilities improved. Chipendo et al. (2012), in a study done in Zimbabwe, stated that most of the participants had considered eye diseases as a normal part of their lives and sign of aging, and, therefore, viewed these diseases as not requiring hospital visits. In agreement with the above study Gilbert et al. (2008) also stated that there are still those stubborn visually impaired persons that will not utilise the eye-care services, even when they are available, accessible and free. Research has shown that the availability of eye-care services alone is not sufficient to encourage people to seek these services as a result to the standard of services offered (Rotchford.et al., 2002). Therefore, there is a need to provide high quality services rather than simply providing facilities that provide high-volume care, as lower uptake of eye-care services and poor quality of service both contribute to high rates of blindness (Gilbert et al., 2008). In other words, in order to avoid a greater number of people undergoing cataract surgery to return with iatrogenic vision loss, high volume and quality cataract surgery must be provided (Jonas et al, 2014). Rotchford et al. (2002) further stated that the goal of reducing visual impairment can be achieved by confronting anxieties at first consultation by the patient.

2.3.2 Ocular risk factors of blindness and visual impairment

Globally, the principal causes of visual impairment and blindness are uncorrected refractive errors and cataracts (Pascollini and Mariotti, 2012). Others causes include glaucoma, age-related macular degenerations, diabetic retinopathy, trachoma and corneal opacities. Posterior segment diseases are also a major cause of visual impairment worldwide and are likely to become more important with the growth of the geriatric population (Pascolini and Mariotti, 2012).

Examples of ocular disease that cause preventable blindness or irreversible damage and visual impairment due to underutilisation of eye-care services include the following:

2.3.2.1 Uncorrected refractive errors

Lewallen and Courtright (2001) reported that natural refractive error is not a significant cause of blindness in most of the population based surveys in Africa, but is a significant cause of visual impairment less than 6/18 but better than 3/60 in the better eye. However, recent information in the literature reports that the most common cause of visual impairment and the second leading cause of treatable blindness and visual impairment is uncorrected refractive error (Budenz et al., 2012; Dandona et al., 2000; Whitfield et al., 1990). Globally an estimated 5 million people are visually impaired due to refractive errors (World Health Organisation, 2009), which is estimated to be responsible for 43% of blindness and visual impairment (Pascolini and Mariotti, 2012; WH0, 2011; Resnikoff et al., 2008). In Iran, Soori et al. (2011) reported refractive error as the second leading cause of visual impairment, even though it can be fully corrected with the use of relatively low cost spectacles. In support of the above global trends, a study done by Budenz et al. (2012) in an urban western African population refractive error was found to be a major cause of visual impairment, even though it can be easily corrected. Furthermore, in South Africa the prevalence of refractive error was estimated to be 6.3% and is due to uncorrected myopia, hyperopia, astigmatism and aphakia (Resnikoff et al., 2008).

The high prevalence of refractive error has severe social and economic effects on individuals and communities, restricting educational and employment opportunities of otherwise healthy people (World Health Organisation, 2009). The impact of visual impairment is significant, due to the fact that uncorrected refractive error can account for twice as many blind-persons per year when compared to cataracts, because of the earlier age of onset of refractive error (Holden and Resnikoff, 2004).

According to Vilas et al. (2007), the high percentage of uncorrected refractive error as a cause of visual impairment is due to the fact that patients with refractive error normally do not seek eye-care services, even if they realise that they do have a problem. Although subjects with refractive error as cause of their visual impairment notice a decrease in vision, they seek treatment only when vision falls to blindness level. That is, patients with refractive error as a cause of their visual impairment probably first cope with the symptoms for a period of time before seeking treatment (Vilas et al., 2007).

2.3.2.2 Low vision

Low vision and blindness are a major health problem worldwide (Oduntan, 2005), however there are variations in their aetiologies due to environmental differences (Potter, 1991). Potter (1991) further stated that in dry areas there is a high prevalence of low vision due to trachoma and that in wet areas low vision is attributed to ochocerciasis (river blindness). The proposed study area has low rainfall, which may be accompanied by low agricultural yield and poor nutrition, which can lead to xerophthalmia (scarring of the cornea), ultimately causing low vision.

According to Resnikoff et al. (2008), low vision and blindness are amongst the 10 most frequent causes of disability globally. In Saudi Arabia the prevalence of low vision was found to be 7.8% (Tabbara & Ross-Degnan, 1986), while in a South African study done by Oduntan et al. (2003) in the Limpopo Province, the prevalence of low vision was found to be 2.43%. The low prevalence was attributed to the availability of affordable and accessible eye-care services provided by the Department of Health of the Limpopo Province.

2.3.2.3 Cataracts

According to Rabiu et al. (2011) and Pascolini and Mariotti (2012), one of the commonest causes of avoidable blindness globally are cataracts. Most of the cataract cases were due to age-related processes, but occasionally children were born with the condition, or the condition may have developed following eye injuries, inflammation and some other eye diseases (World Health Organisation, 2009). The World Health Organisation (2013) estimated that

cataracts represents 41.8% of global blindness and that the incidence of blinding cataracts in the world is estimated to be 1-2 cases per 1 000 population per year (World Health Organisation, 2009). Studies undertaken in Latin America confirmed the importance of cataracts as a cause of blindness and visual impairment (Silva et al., 2002). In 2010, according to Leasher et al. (2014), cataracts still continued to contribute the largest prorportion of blindness in Latin America and the Caribbean.

A study by Lewallen and Courtright (2001) on blindness in Africa reported that half of the blindness was due to cataracts, with a bilateral blinding prevalence of 0.5% responsible for up to 57% of cases of blindness. Rabiu et al. (2011) and Rawashdeh et al. (2005) reported that cataracts was the number one leading cause of blindness, followed by glaucoma, in studies done in Nigeria and South Jordan, respectively. In the Nakuru District of Kenya cataracts was also found to be a major cause of blindness (42%), mainly due to the lack of awareness amongst the population and the cost of correcting the condition (Mathenge et al., 2007). In South Africa, in a study done by Cook and Stulting (1995), cataract prevalence was found to be 0.59% and responsible for 59% of the cases of blindness. In a study done by Oduntan et al. (2003) cataracts featured significantly as the major cause of blindness and low vision.

According to Jonas et al. (2014), the leading causes of blindness did not change from 1990 to 2010, with cataracts being the most frequent cause of blindness, even amongst affluent participants, where quality cataract surgery has doubled in the past decades. In addition to the increase in the volume and quality of cataract surgery, other barriers (such as treatment) exist that need to be overcome in order to eliminate unnecessary blindness due to cataracts (Pascolini and Mariotti, 2012).

2.3.2.4 Glaucoma

Glaucoma is one of the silent blinding eye diseases. It is the third most common cause of blindness in the world. It is regarded as a group of diseases that have as a common end point, a characteristic optic neuropathy which is determined by both structural changes and functional deficits (Grosvenor,

2007). The two most common glaucoma types are primary open angle glaucoma (POAG) - with a slow and insidious onset; and the angle closure glaucoma (ACG), which is less common and tends to be more acute (Grosvenor, 2007). The disease causes progressive optic nerve damage that, if left untreated, leads to blindness. According to Pascolini and Mariotti (2012), glaucoma accounts for up to 8% of blindness globally. An estimated 3 million people in the United States of America have the disease and of these as many as 120,000 are blind as a result. Furthermore, it has been stated that glaucoma is the number one cause of blindness amongst African Americans (Furtado et al., 2012). A study conducted in Latin America and the Caribbean by Silva et al. (2002) reported that glaucoma was responsible for 10.6% of blindness; 85% of the cases had open angle glaucoma and approximately 50% of the patients were undiagnosed.

In African countries, Lewallen and Courtright (2001) found that the epidemiology of glaucoma was not as clear as it should be, due to the fact that all the studies conducted were undertaken on hospital-based populations, and the fact that the definition of glaucoma was inadequate. Lewallen and Courtright (2001), further stated that the surveys done in Africa indicated that open angle glaucoma was still an important cause of blindness. A study undertaken on a Ghanaian population in West Africa found that the prevalence of primary open angle glaucoma was 8.4% (Ntim-Amponsah et al., 2004), which is very high, well above the global estimates (2%) of glaucoma. In Nigeria, glaucoma was also found to be the second most common cause of blindness, accounting for about 18-42% of blindness in the country. While in South Africa, the prevalence of open angle glaucoma and that of primary angle closure glaucoma was found to be 1.5% and 2.3% respectively, accounting for 14% of blindness cases in the population (Department of Health Directorate, 2002).

Treatments to slow the progression of the disease are available, however, at least half of the people who have glaucoma do not receive treatment because they are unaware of their condition and at least half of the eyes are already blind at first presentation (Furtado et al., 2012). Robin et al. (2004), in

agreement with the above, also stated that diseases such as glaucoma can be treated if detected early enough and that the risk of visual disability or loss can be significantly minimised. Glaucoma is, however, still a major public health problem globally. In the United States of America, blindness from glaucoma is believed to impose significant costs annually on the Government in the form of Social Security benefits, lost tax revenues and health-care expenditure (Furtado et al., 2012). There are a number of reasons for blindness due to glaucoma, including the inability to screen and diagnose glaucoma, inadequate or inaccurate therapy, lack of compliance and non-utilisation of available facilities (Robin et al., 2004; Rawashdeh et al., 2005).

2.3.2.5 Retinopathies

According to Kanski (2003), diabetic and hypertensive retinopathies comprise a characteristic group of lesions found in the retina of individuals having had either diabetes mellitus or hypertension for several years. Retinopathy is considered the result of vascular changes in the retinal circulation which occur in a predictable progression, with minor variations in the order of their appearance, among people aged 30 to 69 years (van Dieren et al., 2010). Early changes include vascular occlusion and dilations which progress into proliferative retinopathy. Resultant oedema of the macula area is the major cause of significant reduction of visual acuity (World Health Organisation, 2009).

One of the risk factors of hypertensive retinopathy is uncontrolled hypertension (Department of Health Directorate, 2002), and a study undertaken by Alberts et al. (2005) on Black South Africans found that only 15% of women and 7% of men with hypertension used blood pressure medication. However, in a study undertaken on Black South African adults by Oduntan et al. (2003), hypertensive retinopathy was reported to be one of the minor causes of monocular and binocular blindness.

Diabetic retinopathy is one of the main causes of blindness, after cataracts and glaucoma (Silva et al., 2002), and the risk factors include duration of diabetes, level of glycaemia, presence of high blood pressure, dependence on

insulin and pregnancy, as well as nutritional and genetic factors (World Health Organisation, 2009). According to the World Health Organisation (2009), in 2002 diabetic retinopathy accounted for 5% of blindness globally, representing almost 5 million blind people. Lewallen and Courtright (2001), in a study of blindness in Africa, reported that the prevalence of diabetic retinopathy ranges between 15-50% in African countries. In South Africa, the prevalence of diabetic retinopathy is reported to be 8% (Department of Health Directorate, 2002), which is 3% higher than the global estimates of 5%. According to Kyari et al. (2014), without early detection and improved treatment for diabetic retinopathy, the disease will continue to cause vision loss in diabetic patients as the disease progresses.

According to the Department of Health Directorate (2002), the prevalence of diabetes amongst Indians and Africans in South Africa is further increasing. Type 2 diabetes accounts for 90% of diabetes cases and diabetic retinopathy may be established in these individuals before the diabetes is diagnosed. Rawashdeh et al. (2005) reported that the high incidence of diabetic retinopathy is further exacerbated by lack of knowledge and ignorance on the part of diabetic patients. Furthermore, as the incidence of diabetes gradually increases; there is the possibility that more individuals will suffer from eye complications which, if not properly managed, may lead to permanent eye damage.

2.3.2.6 Age Related Macular Degeneration (ARMD)

Age-related macular degeneration is a condition affecting people over the age of 50 years and involves the loss of a person's central field of vision. It occurs when the macular (or central) retina develops degenerative lesions (World Health Organisation, 2009). According to Pascolini and Mariotti (2012), the prevalence of blindness due to ARMD is estimated to be approximately 5% globally and it ranks as the third cause of visual impairment. In a study done in South Jordan, Rawashdeh et al. (2006), found that the prevalence of ARMD was 1.74%. In a study done in the rural population of Northern India, Gupta et al. (2007) found the prevalence of ARMD to be 0.4% in the 50-90 year age group, rising to 4.6% in the 70 years and older age group. Tang et

al. (2015) and Jonas et al. (2014) also reported that there is indeed an increase in the prevalence of ARMD visual impairment, With a fourfold increase in the number of people aged 50 years and above with the disease globally. Jonas et al. (2014) further stated that this high prevalence of ARMD is similar to that encountered in developed countries and is likely to contribute significantly to the burden of blindness in older people in the developing world (Gupta et al., 2007). According to Lewallen and Courtright (2001), ARMD is considered to be uncommon in Africans, even though a few cases had been reported in Nigeria.

2.3.2.7 Childhood blindness

Data collected from schools for the blind in Latin America revealed that between 34% and 44% of childhood blindness is preventable or treatable (Silva et al., 2002). Globally the prevalence of childhood blindness ranges from 0.2 to 0.5 per 1000 children, depending on level of socioeconomic development. In South Africa the prevalence of childhood blindness is 0.47 per 1000 children (Department of Health Directorate, 2002). Most of the childhood blindness is caused by treatable diseases like congenital glaucoma, congenital cataracts and retinopathy of prematurity, as well as by common, preventable diseases, such as rubella, toxoplasmosis and ophthalmia neonatorum (Silva et al., 2002). Many infants and young children are at high risk for vision problems as a result of hereditary, prenatal or perinatal factors.

The risk factors of childhood blindness need to be identified and tested early and annually in individuals to make sure that their eyes and visual system are functioning normally. Retinopathy of prematurity and amblyopia are also leading causes of visual impairment in children. Amblyopia results in visual problems in very early life. These problems can be prevented or reversed with early detection and appropriate intervention (Furtado et al., 2012).

2.3.2.8 Other possible causes of blindness and visual impairment

Other factors, such as trauma and corneal disorders, are known to cause visual impairment. Corneal disorders encompass a wide variety of infectious and inflammatory eye diseases, such as trachoma (World Health

Organisation, 2009). Significant corneal scarring can ultimately lead to loss of functional vision loss. Globally, blindness resulting from corneal pathology accounts to 5.1% of total blindness and it is rated as the fourth major cause of blindness (World Health Organisation, 2009). Soori et al. (2011), in support of the World Health Organisation (2009), reported a 10% prevalence of blindness due to corneal opacities.

Refractive error is amongst the most common causes of blindness and visual impairment, even though it is the easiest disease to treat. It can be simply diagnosed, measured and corrected with eyeglasses, contact lenses or laser surgery (Sacharowitz, 2005). The provision of spectacles is an extremely cost-effective intervention, which provides immediate correction of the problem (Jonas et al., 2014; Holden and Resnikoff, 2002). In the absence of correction or inadequate correction, distance visual impairment may limit basic everyday function (Smith et al., 2009). Visual impairment costs money and without early intervention, accidents and hospitalisation will more likely occur. The associated public health problems can be avoided by early intervention with spectacles or assistive devices (Norwell & Hiles, 2005).

2.4 KNOWLEDGE OF EYE CARE SERVICES

According to Bradley (2002), knowledge was identified as a determinant of health-care service use. Within the knowledge domain, several themes emerged: the content and amount of information available, the source of the information and the accessibility of the information. Accessibility of information included its attainability and its comprehensibility. Poor knowledge regarding awareness of existing subsidized or free-of-cost services, eye diseases and where to get the required services was regarded as a major barrier to eye-care utilisation (Chandrashekhar et al., 2007; Bhagwan et al., 2006; Farmer et al., 2006; Robin et al., 2004).

Vilas et al. (2007) stated that the predominance of personal reasons, such as lack of knowledge, demonstrate that greater awareness regarding the importance of seeking treatment for visual impairment is needed in order to facilitate uptake of eye-care services. Palagyi et al. (2008) also reported that

lack of awareness of service availability was the most frequent reason for not seeking treatment, especially for rural dwellers. Fletcher et al. (1999) reported that ignorance about the availability of eye-care services was not a reason for the low uptake of the eye camps, citing lack of knowledge as the problem. Rural dwellers, who were almost four times more likely to not seek care, reported lack of knowledge more frequently than their urban counterparts. Lewallen and Courtright, (2001) also reported that lack of awareness that people can get help for their eye problem prevents many from seeking treatment, and also lack of understanding of what will be entailed like time, money or pain.

In a study on rapid assessment of cataracts at pension pay points in South Africa, Cook et al. (2007) found that the single most important barrier to eye-care utilisation, identified in 50.0% of people, was a lack of awareness of the availability of a cure for their severe visual impairment or blindness. This clearly indicated a need to raise awareness of the availability and benefits of eye care-services to indigent people. Eye-care providers must begin to educate individuals at an early age about the role of health-care resources and how to better utilise them. People should know that blindness is not a normal part of ageing. Better education about prevention of blindness in a nation where blindness is rife might help to minimise its prevalence (Robin et al., 2004). Schaumberg et al. (2000) found that better knowledge of the increased rates of blindness and vision impairment among Blacks in the study population of demographic predictors of eye-care amongst women in Baltimore, prompted these health-conscious women to have more frequent eye examinations.

2.5 UTILISATION OF EYE CARE SERVICES

According to Anderson (1995) utilisation of eye care services is affected by the need characteristic, enabling and predisposing factors. This model provides some insights into the factors that create barriers to the use of eye-care services. Keeffe et al. (2002) in a study of utilisation of eye care services by urban and rural Australians, reported that predisposing such personal attributes was found to be associated with utilisation of eye-care services.

Furthermore, enabling factors such, as level of income, private health insurance (medical aid), rural residence and language spoken also influenced the variation in utilisation of eye-care services (Keeffe et al., 2002). People who experience a change in vision or have a known risk factor, such as diabetes (an example of a need factor), have been reported to utilise eye-care services more frequently than those without perceived or diagnosed risk (Keeffe et al., 2002). A study by Palagyi et al. (2008) that found that women with either low vision or blindness (an example of need factor) were more likely to seek treatment than women without impairment, is in agreement with an earlier study by Keeffe et al. (2002). Contrarily, Rotchford et al. (2002) fouund that a majority of participants maintained a remarkable degree of independence, despite their visual impairment, and felt no need to consult as long as they could dress themselves, move around and were able to go to the toilet without any assistance.

Utilisation of eye-care services, in simple terms, could be defined as accessing the available eye-care services (Dandona et al., 2000). Therefore, a potential eye-care patient is one with the motivation to seek services for an examination or for treatment for an eye disease. This motivation has been related to both the educational level, public awareness (Silva et al., 2002) and quality of service received (Rotchford et al., 2002). Gilbert et al. (2008) reported that the lower uptake of eye-care services by poor communities was due to the inequity of access to the services.

It has been reported that, despite the availability of eye-care services in rural areas of Iran (Tehran population) and in a rural county in Ireland, there is a general under-utilisation of available eye-care services (Fotouhi et al., 2006; and Clendenin et al., 1997 respectively). Rotchford et al. (2002) stated that availability of services alone is not sufficient for people to seek eye-care services. Making people realise that they are visually impaired and confronting anxiety at initial presentation is vital to bring about an increase in eye-care service use.

Furthermore, Dandona et al. (2000); Bylsma et al. (2004); Fletcher et al. (1999) and Nirmalan et al. (2004) also reported that a large proportion of those with bilateral (partial and full) blindness had never visited an eye doctor. Had these individuals utilised available eye-care services, much of this disability might not be present. Underutilisation of eye-care services has also been reported in the Mankweng area of Limpopo Province, South Africa by Oduntan and Raliavhegwa (2001). Most of the visual impairment could have been alleviated by access to eye-care services and spectacles, as for preventable blindness to be minimised, people must first utilise the available eye-care resources (Robin et al., 2004).

2.6 BARRIERS OF NON USE OF EYE-CARE SERVICES

According to Ntsoane and Oduntan (2010), the three main reasons for the high prevalence of visual impairment are non-availability, non-accessibility and non-affordability of eye-care services. However, the use of the available, accessible and affordable services may be affected by several factors that may act as barriers to their use. A study done by Fotouhi et al. (2006) in a Tehran population, in support of the above statement, reported that, despite the availability of eye-care services in rural areas of Iran, there are still barriers to the use of available eye-care services. In support of the above statement Norwak et al. (2011), stated that, not only do miserable infrastructure and economic problems create barriers to access of medical services, lack of awareness of eye diseases and methods of treatment are also important limiting factors. In agreement with the above studies, Fotouhi et al. (2006) stated that, even though eye-care services are available to the Tehran population in Iran, over one third of the participants in the survey had never had an ophthalmic examination, nor had over two fifths of the visually impaired population ever received any eye-care service. Rotchford et al. (2002) stated that the availability of services alone is not sufficient for people to seek eye-care services, instead making people realise that they were visually impaired and confronting the anxiety at initial presentation, is vital to increased eye-care use.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1. INTRODUCTION

In the previous chapters, the background to the study and the reasons why the research was conducted were discussed. The public health challenge, the causes and risk factors related to visual impairment and what can be done to prevent avoidable blindness were also discussed. Information regarding knowledge, availability, accessibility and use of available eye-care services was also reviewed. In this chapter, the study settings and methods pertaining to how, when and where the research was done will be discussed in detail.

3.2 RESEARCH DESIGN

The study design was a quantitative, cross-sectional analytic and descriptive study that aimed to describe the size, demography, geographical distribution and also the relationships between the risk factors and visual impairment and blindness. In this study the researcher was investigating and collecting information regarding risk factors related to visual impairment/ blindness in the Dikgale HDSS, at a point in time, in order to determine the burden and determinants of blindness and visual impairment amongst the elderly in the Dikgale HDSS.

3.3 THE STUDY SITE

The study was conducted in the Dikgale Health and Demographic Surveillance System (HDSS) centre, Capricorn District, Limpopo Province, South Africa. Capricorn District has a total population of approximately 1.3 million people and a large proportion of the people live in a rural area (Statistics SA, 2011). Dikgale HDSS is mainly rural, consisting of 15 villages with a total population of approximately 36 000 people. Each village was assigned a code number. The Dikgale HDSS is located approximately 40km north-east of Polokwane. It is a semi-dry, summer rainfall region of South Africa known as the Polokwane plateau, characterised by the savannah climate (South African Veldtypes, 2011).

3.4 RESEARCH METHODS

3.4.1 Sampling

Simple random sample selection was used in the study in order to make sure that conscious and unconscious biases on the part of the researcher were eliminated, That is, in order to make sure that the researcher did not select only cases that would support his or her research hypothesis or expectations, and also to make sure that the characteristics of the population were well estimated (Babbie and Mouton, 2007).

3.4.1.1 Sample Population

The total population of the Dikgale HDSS is approximately 36 000 people. The sample population was all the people (males and females) from 50 years and above who were permanent residents in Dikgale HDSS at the time of the study, approximately 6 600 people. The rationale for limiting the study population to those 50 years and above was that the risk of visual impairment and blindness increases significantly with increasing age (Ramke et al., 2007), is uniquely distributed across age groups and is more common in adults 50 years and older (Resnikoff et al., 2008). That is, most people with visual impairment and blindness are the elderly (World Health Organisation, 2011).

A list of all the 6 600 of all the permanent residents of Dikgale HDSS who are 50 years and older were drawn from the data base and allocated ID numbers.

3.4.1.2. Sampling and sample size

Sampling was done by using the simple formula of probability for simple random sample size determination [n Ó $(1.96)^2$ $p(1-p)/$□^{2}] where 1.96 is a constant when using 95% confidence interval, n stands for sample size, □^{2} stands for standard error (0.02) and p (0.10) stands for proportion in the population (Daly & Bourke, 2000). Taking into consideration the highest prevalence of causes of visual impairment in the literature review in the study, the highest prevalence was reported to be of 10 % as a result of diabetic retinopathy.

n Ó$(1.96)^2$ p (1-p)/^{2}

$n \geq (1.96)^2\ 0.10(1-0.10)/\ (0.02)^2$,

$n \geq 864$

To make provision for people not available to participate in the study, a random sample of 1 000 subjects was selected from the Dikgale HDSS data base.

A cumulative number of participants was then calculated for each village and the sampling interval was calculated by dividing total population by the number of selected participants in each village. The number of participants in the study per village was determined by calculating the population percentage that each village contributed to the total cumulative population. This was done in order to ensure that the estimated 864 participants needed for the study were distributed evenly across the 15 villages. A simple random sampling method was used to select the 1 000 participants in the 15 villages included in the study. Selection of the subjects on the list was done using computer software for random sampling selection. This was done in order to ensure that the estimated 1 000 participants needed for the study would be distributed evenly across the Dikgale HDSS.

3.4.1.3 Ethical issues related to sampling

According to Babbie and Mouton (2007), the fundamental ethical rule is to cause no harm to the research subjects. Therefore, in order to achieve the goal of the fundamental ethical rule, the researcher followed the Helsinki Declaration (World Health Organisation, 2001) by ensuring that the participants had informed consent, right to privacy and were protected from harm at all times. Participants were informed of the aims and the purpose of the study and that their participation was voluntary; and that they had the right to withdraw from participation any time. The nature of the study was also explained to all the participants in a language that the participants understood and a consent form and questionnaire were administered, which the participants were requested to sign and complete. Only those participants who signed the consent forms were included in the study, as it was pre-

planned to give the questionnaire for completion and perform optometric test to the entire participant who were willing to sign the consent form.

3.4.1.4 Sample

The calculated sample size was 864 Black South African males and females who are 50 years and above. However, in order to make provision for people not being available, the sample size used in the study was 1 000. This was significantly above the 364 sample size calculated by following the minimum sample size determination table of Morgan and Krejcie (1994). Therefore, this sample size was sufficient to describe the study population and assess multiple associations.

3.4.2 Data collection

Data collection is the process of collecting information for a study which can be done by measurement with instruments, through questioning ï either by the interviewer or using self-administered questionnaires, by use of documentary sources and by direct observation (Katzenellenbogen et al., 1997).

3.4.2.1 Data collection approach and method

A structured data collection approach was used to collect data in this study. The optometric tests were administered in the same way to the participants by the researcher, with no variation in instructions. The questionnaire was administered by trained fieldworkers. The participants were requested to choose the answers that were most relevant to them from pre-coded choices and also give reasons, according to their experiences, which were later coded.

3.4.2.2 Development of testing instrument and data collection process

Data collection was carried out from February 2012 to August 2012. Optometric procedures were performed and a questionnaire regarding knowledge, need, utilisation of eye-care services and barriers to the use of eye-care services was administered only to the subjects selected as study participants for the purposes of collecting data.

Prevalence rates of blindness and visual impairment were determined from the results obtained from the oculo-visual examinations, such as visual acuity measurements, direct ophthalmoscopy through a dilated pupil, subjective refraction, visual fields measurements, tonometry, Fundus Camera imaging, and the use of Amslerôs grid.

Definition of categories of visual acuity (including blindness and visual impairment)

Categories of visual acuity in the better eye with best correction were defined as follows:

ñNormalò = 6/6 - > 6/18,

ñModerate visual Impairmentò = 6/18 - 6/60,

ñSevere visual impairmentò =<6/60 - 3/60,

ñBlindnessò =VA Ò3/60, or visual field loss of less than 10 degrees in the better eye with best possible correction (World Health Organisation, 1992).

No light perception = ñTotal Blindnessò

The categories were graded using the World Health Organisationôs grading of visual impairment (World Health Organisation, 2011).

Optometric procedures that were performed included a case history, presenting visual acuity, pin-hole visual acuity if the presenting visual acuity is less than 6/18, visual fields using a Novissphere and Amslerôs grid, tonometry, direct ophthalmoscopy through a dilated pupil, fundus camera imaging, and light perception test for cases of blindness.

Optometric procedures performed, as illustrated in Table 3.1, were as follows:

- Case History

Structured questionnaires were administered with no variation of wording regarding the participants. The subjects were requested to answer the structured questions regarding age, previous or present occupation, level of education, whether they are using spectacles or not, whether they sort any

help regarding their problem or not and whether they knew the cause of their visual impairment or not.

- Visual Acuity

Visual acuity in this study was performed to measure the participantsôclarity of vision (Carlson et al., 1990). It was measured with a Logarithm of the minimum angle of resolution (LogMAR) tumbling ñArabic Eòchart at a distance of 4 or 1 metres but not at 40cm. The LogMar chart was chosen because it is currently recognised as the gold standard for visual acuity measurement in clinical trials and scientific studies in optometry and ophthalmology (Adams and Lovie-Kitchin, 2004). The logMAR chart has five letters in each row and the spacing on each row is equal to one letter width, while the row spacing is equal to the height of the letters below. The letter sizes also follow a logarithmic progression, increasing in 0.1 logMAR steps. Each letter on the chart has a score of 0.02 log units and since there are 5 letters per line, the total score per line on the logMAR chart represents a change of 0.1log units. The chart was designed this way so that the clinician who uses it can base the final score precisely on the total letters read so that the findings can be accurate and the test more reliable.

All visual acuity measurements were taken in full daylight with available spectacle correction where applicable. The measurements were done without correction first and with correction in cases where the participant used spectacles. The patientôs right eye was measured first while the left eye was occluded and then the left eye measured whilst the right eye was occluded. The participant was instructed to identify the direction of the tumbling Arabic ñEò until more than half the letters on one line had been missed. The best line seen by the participant was recorded in logMAR form, with a minus or plus sign and a numerical value representing the number of letters missed in the best acuity. Each letter on the chart had a score of 0.02 log units and, since there are 5 letters per line, the total score per line on the log Mar chart represents a change of 0.1log units. This was done in order for the researcher to base the final score precisely on the total number of letters read also in order for the findings to be accurate and the test more reliable. Visual acuity

measurement was first done at 4 meters, but in cases where the participant was unable to read even the largest letter on the chart at that distance, the distance was reduced to 1 meter. Light perception was recorded in cases where the participant only saw the light from the pen torch directed at him. In cases where the participant was not able to see the light, no light perception was recorded

- Pinhole Visual Acuity.

If the presenting VA was found to be less than 6/18(<0.48 logMAR) in either eye then pinhole vision was also measured. This was done in order to determine if the decrease in vision was correctable by lenses. According to Carlson et al. (1990), viewing the acuity chart through a pinhole will increase the patientôs depth of focus and decrease the retinal blur and, therefore, if the retina and visual pathway are free of abnormalities, the participantôs visual acuity will improve. The pinhole disc was used because it is one of the easiest and cost effective methods to determine whether the visual impairment is due to refractive error or pathological conditions (Kanski, 2003). Pinhole visual acuity was also measured using the logMAR chart.

The participant was asked to occlude the eye which was not tested and position the pinhole disc until the chart was in line with the pupil as possible. Then the participant had to read the smallest line of letters seen. The participant continued this process until more than half of the letters on a line were missed. The right eye was measured first whilst the left eye was occluded, then the left eye was measured whilst the right eye was occluded. The best line seen by the participant was recorded in logMar form with, a minus or plus sign and a numerical value representing the number of letters missed in the best acuity. Each optotype on the chart was also scored as a 0.02 logMar unit in order for the researcher to score the findings accurately. The pinhole disc was used because it is one of the easiest and cost effective methods to determine whether the visual impairment is due to refractive error or pathological conditions (Kanski, 1989).

- Dilated direct ophthalmoscopy

Direct ophthalmoscopy was done on a dilated eye by the researcher using an ophthalmoscope in a shaded or dark environment to assess the normality of the media, external and the internal structures. The ophthalmoscope was chosen because it is affordable, available, portable and easy to use and was used to asses the presence or absence of cataract, and to check normality of the cornea anteriorly. The retina was also checked posteriorly in order to check for the presence of significant pallor and Cup/Disk ratio (>0.6), along with pigmentary changes and other signs of glaucoma, C/D asymmetry (>0.2) between the two eyes, presence of cotton wool spots, micro aneurysms, dot and blot haemorrhages, significant macular oedema, neovascularisation at the optic disk and elsewhere and the presence of drusen at the macula area, macular star present, wet age related macular degeneration and observed geographic atrophy. No slitlamp was used in the present study.

The participant was instructed to remove his/her spectacles and to look at a distance non-accommodative fixation target. The participant had to be slightly lower than the examinerõs eye level. The examiner held the handle of the ophthalmoscope in the right hand and aligned the aperture in front of the participantõs right eye to examine the right eye, using the participantõs index fingers to turn the lens wheel. The examiner positioned the ophthalmoscope about 10cm from the participantõs eye at about 15 degrees temporal to the participantõs line of sight. Using the spot beam with +8 to +10 dioptre lens, the examiner focused on the participantõs óris. The optical clarity of the media was checked by moving the ophthalmoscope about 30 degrees in each direction (back and forth and up and down) and the orange fundus reflex relative to dark areas was observed, which indicated media opacities. The lens status was graded as: normal lens or obvious lens opacity present or lens present or intra ocular lens implantation. If the lens could not be examined due to corneal opacification, no view of the lens was recorded. The examiner then slowly reduced the plus power until the hand holding the ophthalmoscope touched the participantõs face and continued reducing lenses until the fundus features came into focus. Optic nerve head was then located and the examiner examined the disc margins, rim tissue, (colour and contour), cup size and

depth. The examiner then determined the Cup/Disc (C/D) ratio and checked the veins for spontaneous pulsation as they exit the cup. The region adjacent to the disc and the midperiphery was then examined by following blood vessels from the optic nerve head in each of the four directions (superior, inferior, nasal and temporal. The vasculature was then evaluated looking carefully at the arteriorvenous (A/V) crossings, retinal background, noting the colour and evenness of the pigmentation. The participant was then directed to look straight ahead and the practitioner moved along the participantõs line of sight and the macular area was evaluated. This was done in order to reduce reflections from the participantõs cornea and avoided constriction of the pupil that could be due to the near response. All the steps were then repeated for the participantõs left eye. Observations for each eye were then recorded separately. All the subjects whose visual impairment was not due to refractive error, cataracts, aphakia, or corneal opacity were dilated and examined and their ophthalmoscopy results were validated by fundus camera images.

The following criteria were used for the classification of posterior segment abnormalities as the cause of visual impairment:-

- ŏ Glaucoma: in the absence of any other obvious cause, presence of significant pallor and Cup/Disk ratio >0.6, along with pigmentary changes and other signs of glaucoma and C/D asymmetry >0.2 between the two eyes.

- ŏ Diabetic Retinopathy: presence of cotton wool spots, micro aneurysms, dot and blot haemorrhages, clinically significant macular edema, neovascularization at the optic disk and elsewhere.

- ŏ Age related macular degeneration: presence of drusen at the macula area, macular star present, wet age related macular degeneration, geographic atrophy observed.

- ➢ Visual Fields

Peripheral visual fields were recorded using a Novissphere. The instrument was chosen because it allows for a small constant target set against a homogenous constant background. This made the novissphere to be more

sensitive and reliable while maintaining simplicity and rapidity of how the procedure is performed. It is also a more tangible, quick and convenient way of assessing visual fields. Furthermore, the novissphere is affordable, available, portable and easy to use. Visual field loss of less than 10 degrees in the better eye with best possible correction was recorded as the cause of visual impairment.

The measurements were done by placing the Novissphere over participantôs eye to rest lightly on the cheek and the brow and held in place by a strap to avoid any movement of the gadget. The participant was then instructed to look at the examinerôs eye through the aperture. The examiner then projected a target light onto the external surface of the Novissphere using the smallest spot of an ophthalmoscope at a distance of two centimeters. The participant was then asked if the target light is visible whilst looking at the examinerôs eye. The examiner had to keep watching the participantôs eye throughout the whole process to be sure that the fixation was steady and that the participant was looking at the examinerôs eye and not at the target. The spot of light was then moved to the next location and the above step repeated. The procedure was repeated until the entire visual field was tested to make sure that the participant was not malingering. The examiner shone light away from the novissphere to check if the participant still reported seeing the light even though there was no light.

To measure the participantôs central fields, the distance between the Novissphere and the participantôs face was increased by holding the Novissphere away from the participantôs face in order to increase the apparent target size. A pinhole occluder was placed in front of the light source to further decrease the size of the target. The participant was then asked if the target light was visible while looking at the examinerôs eye. The examiner had to keep watching the participantôs eye throughou the whole process to be sure that the fixation was steady and that the participant was looking at the examinerôs eye and not at the target. The spot of light was then moved to the next location and the previous step repeated. As illustrated in Table 3.1, any

visual field loss of less than 10 degrees in the better eye with best possible correction was recorded as the cause of visual impairment.

- Amslerôs grid

Amslerôs grid was used at 40cm to assess the integrity of the central visual field corresponding to the macula region (Carlson et al., 1990). It was performed when the participantôs best corrected VA was reduced, or when the macula had and unusual appearance on ophthalmoscopy. The instrument was chosen because it is affordable, available, portable and easy to use and is one of the routine entrance tests for the elderly (Carlson et al., 1990).

The Amslerôs grid test was performed using an Amslerôs grid, occluder and illumination source. The participant wore his best near spectacle Rx and held the occluder. The examiner then held the chart at 30cm from the participant. The participant was then instructed to look at the centre white dot and report if they could see it. Throughout the test the participant continued to look at the white dot and reported if they saw the four corners, any distortions, any wavy lines and if all the little squares were the same size, without moving their eyes. If no distortions or missing grids were reported by the participant, within normal limits (WNL) was recorded. Any distortions and missing grids were recorded as an abnormality of the macular area.

- Tonometry

Tonometry was done using an Icare tonometer because it is non-invasive, portable, involves contact without the use of anaesthetics and is proven to give reliable results. The tonometer detects any erroneous measurements by displaying an error message and sounding two beeps. Any pressure above 24mmHg warranted further investigation.

The participant was instructed to relax and look straight ahead at a specific point. The tonometer was brought near the participants ôeye with the central groove kept horizontal. The distance from the tip of the probe to the participantôs cornea was maintained between 4 and 8mm. The measurement button was then pressed lightly in order to take the measurement. After each successful measurement a short beep was heard. Six measurements are

taken consecutively and the average was displayed on the display. The tonometer detected any erroneous measurements by displaying an error message and two beeps. Any pressure above 24mmHg, as seen in Table 3.1, warranted further investigation.

Other diagnostic tests performed included blood pressure and glucose measurement.

- Blood pressure measurement

Blood pressure was measured using Omron M7. The examiner supported the participantõs arm on a table just above waist level. The participantõs arm was slightly bent, with the palm facing upward so that the stethoscope head could be positioned at the level of the participantõs heart. The forearm of the participant was freed of clothing. The brachial artery was palpated just below the antecubital crease (bend of the elbow) so that the BP cuff could be properly positioned. The bladder of the cuff was centred on the upper arm, overlying the brachial artery, aligning the appropriate arrow on the cuff for the arm being used. The cuff was wrapped smoothly and snugly secured so that the lower border lay approximately 2.5cm above the antecubital crease. A reading was taken by the machine and recorded by the examiner. Three readings were taken and the average of two readings recorded.

- Glucose measurement

Random glucose levels were measured using Accu-check blood glucose meter. The participantõs hands were cleaned with water and soap and wiped with an alcohol swap and dried so that the drop of blood would not spread easily. With the examiner wearing gloves, the side of the participantõs fingertip was selected and pricked with a lancing device. A drop of blood was encouraged to form by gently massaging the finger towards the fingertip so that a drop of blood could form. The drop of blood was then applied to the test strip which was inserted in the glucosemeter. The meter then displayed the reading. Diabetes was defined as capillary glucose level of 11.1mmol/L or higher.

Table 3.1 Summary of investigations (with each purpose) performed in the study

Technique	Equipment used	Purpose of the technique	Abnormal values
Visual Acuity (VA)	Log Mar Chart	To determine magnitude and distribution of B/VI by measuring VA using a Log Mar Chart	VA:6/6->6/18= ñnormalò, 6/18-6/60 = ñvisual Impairment(VI)ò, <6/60-3/60 = ñsevere VIò, VA Ó3/60 Blindness.
Pin hole VA	Pin hole disc	To determine whether the VI is due to pathological causes or refractive error using a pin hole disc	VA:6/6->6/18= ñnormal but needs spectacles correctionò, 6/18-6/60 = ñvisual Impairment(VI)ò, <6/60-3/60 = ñsevere VIò, VA Ó3/60 Blindness.
Direct ophthalmoscopy on a dilated pupil	Ophthalmoscope and dilation	To determine the causes of B/VI by observing structures of the eye	Any media opacities, any pigmentary changes, vascular changes, oedema and etc.
Visual fields	Novissphere	To determine the causes of B/VI by measuring peripheral visual fields	Visual field loss of less than 10 degrees in the better eye
Central visual fields	Amslerôs grid	To determine the magnitude and distribution of ARMD by measuring central visual fields	Any distortions and missing grids
Tonometry	Icare contact Tonometer	To determine the magnitude and distribution of Glaucoma by Intra ocular pressure measurement	>24mmHg
Fundus imaging	Fundus camera	To validate data regarding the causes of B/VI	Any abnormality on the fundus
Blood Pressure measurement	Omron M7	To determine underlying risk factors by measuring blood pressure	Ó140/90 was considered as high.
Random capillary Blood sugar measuserment	Accu-check blood glucose meter	To determine underlying risk factors by measuring capillary glucose level	Ó11.1mmol/L was considered as high.

- *Questionnaire*

A questionnaire (both in English and Sepedi) was designed for the proposed study following the sample contained in the World Health Organisationôs STEPwise approach to chronic disease risk factor surveillance (World Health Organisation, 2011) to ascertain a participantôs demographic information, knowledge of available eye-care services, need and utilisation of eye-care services care and barriers to the use of eye-care services. The questionnaire was translated to Sepedi (the local dialect) and back translated to ensure veracity. Section A of the questionnaire dealt with the demography and knowledge of participantôs regarding eye-care services, while Section B addressed the need of eye-care services. Section C of the questionnaire dealt with the utilisation of eye-care services.

Knowledge of eye-care was evaluated by asking whether respondents knew about available eye-care services, if there was any reason for not undergoing regular eye examination; how often should a person should go for a regular eye examination (those who reported annual eye examinations at a particular service provider were considered knowledgeable with respect to how often a person should go for regular eye examination and where to find these services).
All the responses regarding knowledge in relation to eye-care services were then computed and the participants who got 5/5 from the knowledge section were considered to be knowledgeable regarding eye-care services. Participants who did not score 5/5 were considered not to be knowledgeable regarding eye-care services.

The need for eye-care services was determined by asking participants if they had experienced any symptoms that required them to visit an eye clinic (e.g. poor distance and near vision; eye ache, itching eyes, headaches, as well as the presence of systemic diseases like diabetes and high blood pressure). The presence of any such symptom was considered a need factor for eye-care services for a participant. A history of eye-care visits was considered as eye-care utilisation. Barriers to eye-care utilisation were determined by asking participants if there were any reasons preventing them from seeking eye-care services.

The questionnaire was then administered to respondents by the researcher and research assistants to ensure greater percentage of return and at the same time accord the participants the opportunity to clarify any misunderstandings of the questions. The questionnaire was distributed to the participants chosen as the sample for completion. Those who could not read or write were assisted with completing the questionnaire by the researcher.
Data collection was carried out between August 2012 and May 2013.

- *Pilot Study*

Prior to the main study, a pilot study was conducted by the researcher in one of the villages included in the study. The participants (subjects) in the pilot

study were not included in the main study. The main idea behind the pilot study was to test if there were aspects of the questionnaire that the participants had difficulty understanding (Saunders, 2000). In addition, it helped to check the reliability, validity and the objectivity of the instrument. Before the pre-testing of the subjects, the questionnaire was administered to five optometrists who had been in practice for five years or more in order to verify content validity. Subsequently, the pilot study (pre-testing of questionnaires) was conducted on a small population sample in three stages. Firstly, it was administered to 10 subjects in a village which was included in the study. This was to ensure that the questionnaire measured what it intended to measure and to ensure that it presented no difficulty to the participants. Secondly, the original 10 subjects were re-tested after four weeks to establish whether or not they would give similar answers to those previously given (reliability of the questionnaire). Finally, the questionnaire was tested on two other groups of 5 subjects (from the same village) and findings compared to those previously obtained. This was to ensure that the results obtained were not obtained by chance. During the pilot study, the skills of administering the questionnaire were honed in order to eliminate biases such as information and communication bias.

3.4.2.3 Ethical considerations related to data collection

I. The proposal was submitted to the University of Limpopo, Medunsa Research and Ethics Committee (MREC) for approval.
II. The researcher adopted the Helsinki Declaration (World Health Organisation, 2001) and therefore:
    - ŏ Participants were informed about the aims and the purpose of the study and that their participation was voluntary and that they had the right to abstain from participation.
    - ŏ Participants were requested to sign the consent form. Only those who signed the consent forms were included in the study.
    - ŏ Field workers were requested to sign a form regarding confidentiality of information collected from the participants.
    - ŏ Any participant diagnosed with visual or pathological problems was referred to the hospital for further assistance.

3.5 INCLUSION CRITERIA

All the permanent residents of the Dikgale HDSS who were 50 years and older were included in the study.

3.6 DATA ANALYSIS

3.6.1 Summary and interpretation of the research findings

The computer software Statistical Package for Social Sciences Version 23 (SPSS 23) was used to analyse quantitative data. Descriptive statistics (means, medians, standard deviations, confidence intervals) were conducted to describe the characteristics of the subjects. Prevalence of visual impairment or blindness was calculated as the ratio of the number of respondents with visual impairment or blindness (in the better eye) to the total number of people who were evaluated. Overall prevalence was calculated and also within subgroups were defined by gender. To determine the predictive values for the determinants of visual impairment the Pearsonôs Chi square (with a 0.05 significant level) was used in order to eliminate the possibility that the observed results happened by chance. If the *p*-value was less than 0.05, the parameter was considered statistically significant. Any *p*-value of more than 0.05 the parameter was considered statistically insignificant. If the value between the upper bound and the lower bound of the confidence interval did not include 1, it was said to be statistically significant and any value that included 1 as a value was said to be not statistically significant. Differences in proportions were assessed by chi-square analysis. The odds ratios were calculated and interpreted using the 95% confidence interval to determine the strength of associations between visual impairment and risk factors. Binary and multinomial logistic regressions analyses were used to describe the relationships between visual impairment and demographic, socioeconomic factors ocular risk factors and chronic diseases. Binary logistic regression modelling was used to assess categorical dependant variables. Multinomial regression modelling was used as an extension of the model to further understand the extent of visual impairment. For multivariate analyses, factors with a *p*-value <0.20 were retained, as well as factors modifying the regression coefficient of the main determinant by

more than 10%. All reported *p*-values which were two-sided and *p*-values <0.05 were considered significant.

The study used descriptive analytical methods to describe the outcome of the research.

3.7 INTERNAL AND EXTERNAL VALIDITY OF THE STUDY

3.7.1 Validity

Validity refers to the extent to which an empirical measure adequately reflects to real meaning of the concepts under consideration (Babbie and Mouton, 2007).

Internal validity was assured by standardised techniques and the translation and back translation of the questionnaires. Standard of practice was followed for each investigation to ensure quality assurance and to minimise interpersonal variability.

External validity was assured by using, to a maximum, internationally validated questionnaires, international standard case definitions and measurements as contained in the World Health Organisationôs STEPS surveillance questionnaire.

The population was carefully defined by the samples that represent it. All participants were given the questionnaire for completion and optometric procedures were also undertaken on them. Appropriate techniques of statistical analysis were used (as indicated); the descriptives were applied to analyse data.

3.7.2 Reliability

According to Babbie and Mouton (2007), reliability refers to a matter of whether a particular technique applied repeatedly to the same objects yields the same results each time. In order to get rid of unreliable results, instruments used to collect data must be clear and specific and proper training and practice must be done by research assistants.

Therefore, in this study, the training of field workers on how to administer questionnaires was undertaken to increase participantsô reliability. Sepedi-speaking final year optometry students were trained specifically for the

procedures employed in the study on how to use the equipment and do the assigned tests properly. Each optometric procedure was carried out by the researcher throughout the study.

3.7.3 Bias

Bias is a deviation from information which is correct and true. It refers to systematic deviation from the truth (Katzenellenbochen et al., 1997). It is distinct from precision or random error, which refers to repeatability. A small degree of bias may be inevitable in research but the first step in assessing the validity of a study estimate is to identify potential biases (Katzenellenbochen et al., 1997). The potential biases were addressed as follows.

- ŏ Selection bias was eliminated by performing appropriate random sampling in the overall population.
- ŏ Sampling bias was eliminated by selecting a large random sample size for this study from the study population.
- ŏ Communication bias was eliminated by providing the research assistants with sufficient training prior to the study.
- ŏ Systematic biases were minimised by assuring internal and external biases.
- ŏ Recall biases were controlled by providing the research assistants with sufficient training prior to the study.

3.8 REPORTING AND UTILISATION OF RESULTS

Data reporting and dissemination of information included the following:

- ŏ Dissertation.
- ŏ Publication in peer-reviewed journals.
- ŏ Appropriate recommendations to the Department of Health and Social Development.

3.9 SIGNIFICANCE OF THE STUDY

Findings of this study will help to:

- ŏ Provide current data to the Department of Health essential for the planning, implementation and evaluation of services for the prevention, control and treatment of reversible blindness and visual impairment

and to setting up of priorities among eye-care services as set out in the VISION 2020: Right to sight objectives. The VISION 2020 recommendation is that health demographic data should be reviewed every five years.

- ŏ Reduce the burden of blindness and visual impairment and its consequences on the community by educating, screening and referring all eye conditions that need to be managed.
- ŏ To promote the health and wellness of society as a whole, as it is important to know the burden of disease in order to prevent eye problems.
- ŏ To serve as baseline information for other population-based studies on blindness and visual impairment in future.

3.10 CONCLUSION

In this chapter the research setting was discussed in detail. A step by step explanation of what was done in the research, how it was carried out and where and when was it done was discussed. That is, the aims and objectives of the study and how they were achieved were discussed. The type of research design and methodology used and why was it chosen over other methodologies was also discussed. The type of instruments used to collect data and the rationale for choosing those instruments were discussed. Further, the data collection process (development and collection) were also illustrated. Ethical consideration for the participants, internal and external validity of the researcher and research assistants, and reliability of the data collecting instrument were also discussed. Further, why the chosen study site was used instead of other settings, how the sample population was chosen and how data was analysed was also discussed in this chapter.

CHAPTER FOUR

4.0 RESULTS

4.1. CHARACTERISTICS OF THE RESPONDENTS

A total of 704 respondents out of 1 000 selected participants completed the questionnaire and were examined, a response rate of 70.4%. The respondents were Black South African adults above 50 years of age with permanent residence in the Dikgale HDSS. The mean age of respondents was 65.6±10.3 years (range, 50 to 102 years).

The characteristics of the study participants are presented in Table 4.1. Out of the 704 participants, 508 (72.1%) were women and 196 (27.8%) were men. Thirty five percent of respondents were in the 60-69 year age group, with a proportion of 33.9% females and 37.8% males. Two hundred and eighty one (39.9%) respondents had completed high school and/or higher education. Nearly 72% of the participants were pensioners. Two hundred and ninety two (41.4%) respondents had hypertension, with a similar percentage among males (42.3%) and females (41.4%). The prevalence of the use of tobacco products was similar in females (40.0%) and males (38.3%), and 11.4% had a random capillary glucose concentration equal or higher than 11.1mmol/L. The prevalence of refractive error was higher in males (18.4%) than in females (12.6%). One hundred and twenty two (14.2%) participants had obvious cataracts, with a similar percentage among males (17.8%) and females (17.1%).

Table 4.1: Characteristics of the participants

Characteristics factors	Categories	Gender N (%)		Total N (%) N=704
		Female=508	Male=196	
Age Categories	50-59	164 (32.3)	55 (28.1)	219 (31.1)
	60-69	172 (33.9)	74 (37.8)	246 (34.9)
	70-79	119 (23.4)	48(24.5)	167 (23.7)
	80+	53 (10.4)	19 (9.7)	72 (10.2)
Education Level	No formal education	159 (31.3)	47 (24.0)	206 (29.3)
	Up to grade 7 level	142 (28.0)	75 (38.3)	217 (30.8)
	Grade 8 level and higher	207 (40.7)	74 (37.8)	281 (39.9)
Occupational Status	Unemployed	17 (3.3)	0 (0.0)	17 (2.4)
	Employed	132 (26.0)	50 (25.5)	182 (25.9)
	Pensioner	359 (70.7)	146 (74.5)	505 (71.7)
Income status (Monthly)	R1000 and less	127 (25.0)	39 (23.4)	166 (23.6)
	Above R1000	381 (75.0)	157 (80.1))	538 (76.4)
Hypertension	Ó140/Ó90/both	209 (41.4)	83 (42.3)	292 (41.4)
Tobacco use	Yes	203 (40.0)	75 (38.3)	278 (39.4)
Glucose (random)(mmol/L)	Ó11.1mmol/L	52 (10.2)	28 (14.2)	80 (11.4)
Refractive errors	Yes	64 (12.6)	36 (18.4)	100 (14.2)
Cataracts	Yes	87(17.1)	35 (17.9)	122 (17.3)

SECTION A: PREVALENCE AND DETERMINANTS OF VISUAL IMPAIRMENT (BINOMIAL CATEGORIES)

4.2 PREVALENCE AND DISTRIBUTION OF VISUAL IMPAIRMENT.

4.2.1. Prevalence and distribution of visual impairment by gender

In Table 4.2 the prevalence and distribution of visual impairment are presented. The prevalence of presenting bilateral visual impairment meeting the criteria in the better eye was 26.4% (186) out of the 704 observed respondents. The majority of the participants had moderate visual impairment, with a similar prevalence among males (75.0%) and females (67.5). Twenty seven (14.5%) of those with visual impairment were classified as blind. Out of the 126 females and 60 males with visual impairment, 13.5% and 16.7% respectively were classified as blind.

Table 4.2 Prevalence of visual impairment by gender

Severity of Visual impairment	Total N (%)	Female N (%)	Male N (%)
	186	**126**	**60**
Moderate	130 (69.9)	85 (67.4)	45 (75.0)
Severe	29 (15.6)	24 (19.0)	5 (8.3)
Blindness	27 (14.5)	17 (13.5)	10 (16.7)

The 186 participants with visual impairment were then corrected for refractive error and the severity of their visual impairment post-correction is presented in Table 4.3. Out of the 186 respondents, 106 (57.0%) were found to still have visual impairment even after pinhole visual acuity measurements. Seventy six percent had low vision and 23.6% were blind. Out of those who had low vision 74.0 % were females.

Table 4.3 Prevalence and distribution of low vision and blindness by gender

Severity of Visual impairment		Total N (%)	Female N (%)	Male N (%)
		106	**76**	**30**
Low vision N=81	Moderate	**62 (58.5)**	47 (61.8)	15 (50.0)
	Severe	**19 (17.9)**	13 (17.1)	6 (20.0)
Blindness N=25		**25 (23.6)**	16 (21.1)	9 (30.0)

4.2.2 Prevalence and distribution of ocular risk factors with visual impairment

In Table 4.4 the prevalence and distribution of ocular risk factors by gender among those who are visually impaired are presented. Out of the 186 participants with visual impairment, 46.2% had cataracts, 39.8% had refractive error, 6.5% had corneal opacifications, 4.3% had glaucoma and 3.2% had other diseases, including retinopathies, retinal afferent pupillary defects, retinitis pigmentosa, amblyopia and macula defects. Out of the 86 participants who had cataracts, 70.9% were females and 29.1% were males. Of the 74 (39.6%) participants who had refractive errors, 62.2% were females and 37.8% were males.

Table 4.4 Prevalence of ocular risk factors by gender

Total Participants		**Total N (N%)** **N= 704**	**Female** **N=508**	**Male** **N-196**
Total with visual Impairment		**186**	**126 (67.7)**	**60 (31.7)**
Ocular disorders	Cataracts	**86 (46.2)**	61 (70.9)	25 (29.1)
	Refractive error	**74 (39.8)**	46 (62.2)	28 (37.8)
	Corneal opacification	**12 (6.5)**	9 (75.0)	3 (25.0)
	Glaucoma	**8 (4.3)**	5 (62.5)	3 (37.5)
	Others	**6 (3.2)**	5 (83.3)	1 (16.7)

4.3 ASSOCIATION BETWEEN RISK FACTORS AND VISUAL IMPAIRMENT.

4.3.1 Association of risk factors with visual impairment

Table 4.5 presents the association between visual impairment and risk factors. There was no significant association with gender, income status, diastolic blood pressure, and capillary glucose levels with visual impairment (p>0.05). There was a significant association with age (p=0.000), level of education (p=0.000), and occupational status (p=0.002) with visual impairment. Hypertension *(*p=0.002) and tobacco use (p=0.007) were also significantly associated with visual impairment.

There was a significant increase in visual impairment with age (p=0.000) and lack of education (p=0.000). Participants who were employed had a lower prevalence of visual impairment when compared to pensioners and those who were not employed. The prevalence of visual impairment increases with the decrease in income level of a participant per month. The prevalence of visual impairment was higher in those with hypertension and in those whose glucose levels were >11.1mmol/l.

Table 4.5 Association of demographic risk factors with visual impairment

Risk Factor	Category	Total	Visually impaired N (%)	*p*-value
Gender	Female	**508**	126 (24.8)	0.117
	Male	**196**	60 (30.6)	
Age	50-59	**219**	38 (17.4)	0.00
	60-69	**245**	49 (20.0)	
	70-79	**168**	56 (33.3)	
	80+	**72**	43 (59.7)	
Level of Education	Never went to school	**206**	77 (37.4)	0.000
	Up to primary level	**217**	58 (26.7)	
	High school and above	**281**	51 (18.1)	
Occupational Status	Employed	**206**	129 (62.6)	0.002
	Pensioner	**217**	159 (73.3)	
	Unemployed	**281**	230 (81.9)	
Income status	R1000 and less	**154**	33 (21.4)	0.067
	Above	**550**	153 (27.8)	
Hypertension(≥140/≥90/both)	No	**412**	90 (21.8)	0.002
	Yes	**292**	96 (32.9)	
Glucose (random)(mmol/L)	<11.1	**624**	160 (25.6)	0.190
	Ó11.1	**80**	26 (32.5)	
Tobacco Use	No	**375**	97 (22.8)	0.007
	Yes	**278**	89 (29.1)	

P=value for trend

4.3.2 Association of ocular and other risk factors with visual impairment

The association between ocular risk factors and visual impairment are shown in Table 4.6. Ocular disorders, namely cataracts, glaucoma, retinitis pigmentosa, retinopathies, age related macular degeneration and corneal opacifications were grouped together as pathological disorders as some counts were too small for analysis. Overall pathological disorders contributed 59.7% to the prevalence of visual impairment when compared to refractive error, which contributed 40.3% of impairment. Refractive error (p=0.000) and pathological disorders (p=0.000) were significantly associated with visual impairment.

Table 4.6 Associations of ocular and other risk factors with visual impairment.

Risk factors	**Category**	**Total** N=704	**Visually impaired** N (%)	**p-value**
Ocular Risk Factor				
Refractive error	No	**603**	114 (18.9)	0.000
	Yes	**101**	72 (71.2)	
Pathological disorders	No	**525**	58 (11.0)	0.000
	Yes	**179**	128 (71.5)	
Other Risk Factors				
Use of eye-care services	No	**410**	90 (22.0)	0.001
	Yes	**294**	96 (32.7)	
Use of spectacles	No	**575**	159 (27.7)	0.118
	Yes	**129**	27 (20.9)	
Knowledge regarding eye-care services	No	**106**	31 (29.2)	0.474
	Yes	**598**	155 (25.9)	
Needs for eye-care services	No	**465**	95 (20.4)	0.000
	Yes	**239**	91 (38.1)	

p-value for trend

Out of the 704 subjects, 239 (33.9%) had a need for eye-care services. Two hundred and ninety-four (41.8%) of the respondents had utilised eye-care services. The prevalence of visual impairment among those who utilised the eye-care services was 32.7%. The majority (598 or 84.94%) of the participants had knowledge regarding available eye-care services, however, knowledge regarding eye-care services was not significantly associated with visual impairment (pÓ0.05). The prevalence of visual impairment among those who had a need for eye-care services was 38.1%.

Use of eye-care services (p=0.001) and a need for eye-care services (p=0.000) are significantly associated with visual impairment, but the use of spectacles was not significantly associated with visual impairment (pÓ0.05).

4.4 RELATIONSHIP BETWEEN VISUAL IMPAIRMENT AND RISK FACTORS

Table 4.7 Predictors of visual impairment-Univariate logistic regression

Risk factors	Category	Univariate Logistic Regression	
		OR (95%CI)	p-value
Gender	Male (Ref)		
	Female	1.3 (0.9-1.9)	0.118
	50-59 (Ref)		
	Age 60-79	1.3 (0.7-2.0)	0.360
Age	Age 70-79	**2.6 (1.6-4.1)**	**0.000**
	Age 80+	**6.2 (3.3-11.5)**	**0.000**
	<R1000 (Ref)		
Income Status	>R1000	1.4 (0.9-2.2)	0.113
Education	High school Plus (Ref)		
	Up to primary level	1.2 (0.5-2.6)	0.714
	Never went school	**2.2 (1.5-3.3)**	**0.000**
	<140mmHg/<90mmHg(Ref)		
Hypertension	Ó140mmHg/Ó90mm Hg	**1.8 (1.3-2.5)**	**0.000**
	<11.1mmol/l (Ref)		
Glucose	Ó11.1 mmol/l	1.4 (0.9-2.3)	0.192
Tobbaco	No (Ref)		
	Yes	**1.6 (1.1-2.2)**	**0.007**
Refractive error	No (Ref)		
	Yes	**54.9 (26.8-112.5)**	**0.000**
Pathological	No (Ref)		
	Yes	**65.6 (34.3-125.3)**	**0.000**
Use of eye-care services	Yes (Ref)		
	No	**2.2 (1.5-3.3)**	**0.000**
Use of spectacles	No (Ref)		
	Yes	1.4 (0.4-1.1)	0.119
Knowledge re: eye-care services	Yes (Ref)		
	No	1.2 (0.8-1.9)	0.475
Need for eye-care services	Yes (Ref)		
	No	**2.4 (1.7-3.4)**	**0.000**

Hosmer-Lemeshow chi (8)=7.65, p=0.468, classification table=83.6%

4.4.1 Relationship between risk factors and visual impairment.

Logistic regression was used to assess the determinants of visual impairment. Predictive values (the odds ratio (OR) and the corresponding significant level) of various risk factors to identify the determinants of visual impairment are outlined in Table 4.7.

The odds of having visual impairment increased significantly with age, ranging from 1.3 in the age group 60-69 to 6.2 in the 80+ category (p=0.000). Participants with low education level were more likely to be visually impaired (p=0.000) when compared to high school and higher education level

participants. The presence of hypertension increased the odds of having visual impairment by 1.8 (95%), with a confidence interval of 1.3-2.5. Tobacco use was significantly associated with visual impairment (p=0.007) with OR 1.60 (95%CI, 1.1-2.2).

Participants with refractive error are more likely to have visual impairment compared to those without refractive error OR 54.9 (95%CI, 26.8-112.5). Visual impairment is more likely in participants with pathological disorders than in those without pathological disorders OR 65.6. Participants who do not use eye-care services are 2.23 (95%CI, 1.5-3.3) times more likely to have visual impairment than those who do not use the available eye-care services The odds ratio of those who did not have symptoms (no need to seek eye-care services) was OR 2.4 (95%CI, 1.7-3.4) more likely to have visual impairment than those who had a need to seek such services.

4.4.2 Multivariate logistic regression model

All variables with a *p*-value of less than 0.20 were used in the multivariate logistic regression model. Table 4.8 shows the binary multivariate logistic regression model for visual impairment. Age 80+ (*p*=0.003), refractive error (*p*=0.000), pathological causes (*p*=.000) and tobacco use (*p*=0.02) remains significantly associated with visual impairment in the multivariate logistic regression model. Gender, education, income, use of eye-care services, hypertension, knowledge of available eye-care services and need for eye-care services were not significantly associated with visual impairment (*p*>0.05).

Table 4.8 Multivariate Logistic Regression Model for visual impairment

Risk Factor	Category	Odds Ratio 95% C.I	p-value
Age	Age 50-59 (Ref)		.021
	Age 60-69	1.2 (0.6 - 2.3)	.636
	Age 70-79	1.5 (0.8 - 3.0)	.247
	Age 80+	**3.8 (1.6 - 9.0)**	**.003**
Educational status			
	High School and Above(Ref)		.175
	Up to grade 7	1.2 (0.6 - 2.3)	.585
	Never went to school	1.8 (0.9 - 3.5)	.069
Hypertension	<140mmHg/<90mmHg(Ref)		
	Ó140mmHg/Ó90mm Hg	1.2 (0.3 - 5.3)	0.798
Refractive error			
	No (Ref)		
	Yes	**53.4 (25.5 - 112.0)**	**0.000**
Pathological disorders			
	No (Ref)		
	Yes	**54.2 (27.7 - 106.3)**	**.000**
Tobacco use	No (Ref)		
	Yes	**1.9 (1.1 - 3.3)**	**0.020**
Need for eye-care services	No (Ref)		
	Yes	1.4 (0.8 - 2.5)	.184
Use of eye-care services	Yes (Ref)		
	No	1.3 (0.8 - 2.2)	.338
Constant		0.009	0.000
Hosmer and Lemeshow goodness-of-fit test	p=0.4687		
Classification table	88.8%.		

The odds ratio of having visual impairment increases significantly with age, ranging from 1.2 (95%CI, 0.6-2.3 in the age group 60-69 to 3.8 (95%CI, 1.6-9.0) in the age group 80+. The likelihood of having visual impairment due to tobacco use is OR 1.9 (95%CI, 1.1-3.3). Non-use of available eye-care services increases the risk of having visual impairment OR 1.3 (95%CI, 0.8-2.2). Having visual impairment increases significantly with the presence of refractive error OR 53.4 (95%CI, 25.5-112.0). Participants with pathological disorders are more likely to have visual impairment than those without pathological disorders OR 54.2 (95%CI, 27.7-106.3).

SECTION B: PREVALENCE AND DETERMINANTS OF THE SEVERITY OF VISUAL IMPAIRMENT

This section discusses visual impairment according to its severity.

4.5 PREVALENCE OF MODERATE VISUAL IMPAIRMENT, LOW VISION AND OCULAR DISEASES.

4.5.1 Visual impairment categories

To understand visual impairment further, its severity was explored. Table 4.9 presents the results for the prevalence of the severity of visual impairment and gender distribution. The prevalence of moderate and severe visual impairment and blindness meeting the criteria of the better eye was 130 (69.9%), 29 (15.6%) and 27 (14.5%) respectively. The prevalence of low vision was 11.5 %. The prevalence of moderate visual impairment was higher in males (75.0%) than in females (67.4%), while severe visual impairment was higher in females (19.0%) when compared to (8.3%) to males. The prevalence of blindness among females was almost half (8.7%) that of males (16.7%).

Table 4.9 Prevalence of visual impairment and low vision based on visual acuity categories

Visual Acuity Categories			Number of Respondents (N=704)				
			Normal VA= N (%)=518	Visual impairment Total N (%)=186			
Presenting VA		**Total N**	**Normal**	**Total with VI**	**Moderate**	**Severe**	**blindness**
	All	**704**	**518 (73.6)**	**186 (26.4)**	130 (69.9)	29 (15.6)	27 (14.5)
	F	**508**	**382 (73.7)**	**126 (24.8)**	85 (67.4)	24 (19.0)	17 (8.7)
	M	**196**	**136 (69.3)**	**60 (30.6)**	45 (75.0)	5 (8.3)	10 (16.7)
Corrected VA		**Total**	**Normal**		**Low vision N=81 (11.5)**		**Blindness**
					Moderate	**Severe**	
	All	**704**	**602 (85.5)**	**106 (15.1)**	62 (58.5)	19 (17.9)	25 (23.6)
	F	**508**	**433 (85.2)**	**76 (14.9)**	47 (61.8)	13 (17.1)	16 (21.2)
	M	**196**	**169 (86.2)**	**30 (15.3)**	15 (50.0)	6 (20.0)	9 (30.0)

After spectacle correction, the prevalence of visual impairment decreased from 26.4 % to 15.1%. Moderate visual impairment was reduced from 69.9% to 58.5%, but the severe visual impairment and blindness categories increased from 15.6% to 17.9% and 14.5% to 23.6% respectively. After spectacle correction, the prevalence of moderate visual impairment decreased from 75% to 50% amongst the male respondents. The prevalence of moderate visual impairment decreased from 67.4% to 61.8% amongst female respondents. Among males, the severe visual impairment category constituted 8.3% of presenting visual impairment compared to the 20.0% of the corrected visual impairment. The prevalence of severe visual impairment decreased from 19.0% to 17.1% amongst female respondents.

4.5.2 Prevalence and association between severity of visual impairment and ocular risk factors

The association between ocular risk factors and the severity of visual impairment is presented in Table 4.10. Cataracts was significantly associated with visual impairment (p= 0.000) and its prevalence increased with the severity of visual impairment from 40.0% to 60.7%. Glaucoma was significantly associated with visual impairment (p= 0.000). The prevalence of moderate visual impairment was mostly due to refractive error (53.1%) and

cataracts (40.0%). The prevalence of severe visual impairment was mostly due to cataracts (60.7%), followed by glaucoma at 14.3%. The prevalence of other ocular risk factors of visual impairment was too low for analysis purposes.

Table 4.10 Association between severity of visual impairment and ocular risk factors

Determinants of visual Impairment	Total with VI N=186	Moderate N (%)=130	Severe N (%)=56	*p* -value
Cataracts	**86 (46.2)**	52 (40.0)	34 (60.7)	0.000
Refractive error	**74 (39.8)**	69 (53.1)	5 (8.9)	0.000
Corneal opacification	**12 (6.5)**	5 (3.8)	7 (12.5)	0.000
Glaucoma	**8 (4.3)**	0 (0.00)	8 (14.3)	0.000
Other causes	**6 (3.2)**	4 (3.1)	2 (3.6)	0.048

4.5.3 Relationship patterns between severity of visual impairment and risk factors (multinomial logistic analysis)

To further explore the relationship pattern between the severity of visual impairment and risk factors, multinomial logistic regression was employed. First, association of risk factors with the categories of severity of visual impairment was determined using a 0.05 significant level. All those with a *p*-value of less than 0.05 in Table 4.11 were used in the multinomial logistic analysis. The categories for 6/60 to 3/60 were merged with >3/60 to blindness due to the fact that the value for total blindness was small.

4.5.3.1 Association of risk factors and the severity of visual impairment

In Table 4.11 the association between risk factors and severity of visual impairment is presented. Gender, income status, diastolic blood pressure and knowledge regarding available eye-care services were not significantly associated with the severity of visual impairment ($p>0.05$). In the case of age there was an increase in both moderate and severe visual impairment with increasing age. There was a significant association between age and the severity of visual impairment ($p=0.000$). There was a decrease from 12.3% to 5.0% in the prevalence of visual impairment from moderate to severe in the 50-59 age group.

Table 4.11 Association of risk factors and the severity of visual impairment

Risk factor	Category	Binocular Visual acuity categories			*p*-value
		Normal	Moderate	Severe	
Gender	Female	382 (75.2)	84 (16.5)	42 (8.27)	0.142
	Male	136 (69.4)	45 (22.9)	15 (7.65)	
Age	50-59years	181 (82.6)	27 (12.3)	11 (5.0)	**0.000**
	60-69years	197 (80.1)	37 (15.0)	12 (4.9)	
	70-79years	111 (66.1)	43 (25.7)	13 (7.8)	
	80+	29 (40.3)	22 (30.6)	21 (29.2)	
Educational Level	No Formal Education	129 (62.6)	50 (24.3)	27 (13.1)	**0.000**
	Grade 1-7	159 (73.3)	42 (19.4)	16 (7.4)	
	Grades 8 +	230 (81.9)	37 (13.2)	14 (5.0)	
Occupational Status	Employed	152 (83.5)	22 (12.1)	8 (4.4)	**0.006**
	Pensioner	355 (70.3)	104 (20.6)	46 (9.1)	
	Unemployed	11 (64.7)	3 (17.6)	3 (17.6)	
Income status	R1000 and less	121 (78.6)	21 (13.6)	12 (7.8)	0.217
	Above R1000	397 (72.2)	108 (19.6)	45 (8.2)	
Hypertension	<140mmHg/<90mmHg	322 (78.2)	60 (14.6)	30 (7.3)	**0.004**
	Ó140mmHg/Ó90mmHg	196 (67.1)	69 (23.6)	27 (9.2)	
Glucose	<11.1mmol/l	464 (74.4)	113 (18.1)	47 (7.5)	0.252
	Ó11.1mmol/l	54 (67.5)	16 (20)	10 (12.5)	
Tobacco use	No	329 (77.2)	65 (15.3)	32(7.5)	**0.019**
	yes	189(68.0)	64 (23.0)	25 (9.0)	
Use of eye-care	No	320 (78.0)	70 (17.1)	20 (4.9)	**0.000**
services	yes	198 (67.3)	59 (20.1)	37 (12.6)	
Need for eye-care	No	370 (79.6)	67 (14.4)	28 (6.0)	**0.000**
services	Yes	148 (61.9)	62 (25.9)	29 (12.1)	
Knowledge regarding	No	75 (70.8)	23 (21.7)	8 (7.5)	0.620
available eye-care services	yes	443 (74.1)	106 (17.7)	49 (8.2)	
Refractive error	no	489 (81.1)	62 (10.3)	52 (8.6)	**0.000**
	yes	29 (28.7)	67 (66.3)	5 (5.0)	
Pathological disorders	no	467 (89.0)	52 (9.9)	6 (1.1)	**0.000**
	yes	51 (28.5)	77 (43.0)	51 28.5)	

a. Severe= (6/60-total blindness) b. *p*-value for trends

The prevalence of severity of visual impairment decreased significantly (p=0.000) from moderate to severe with lack of education. There was a significant association between severity of visual impairment and occupational status (p=0.006). The prevalence of severe visual impairment increased from 4.4% when the participant was employed to 17.6% when the participant was not employed.

There was a significant association between systolic blood pressure and severity of visual impairment (p=0.001). The prevalence of severity of visual impairment is not significantly associated with blood glucose concentration and income level (p>0.05). Hypertension was significantly associated with severity of visual impairment (p=0.004). Tobacco use was significantly associated with visual impairment (p=0.019). The prevalence of visual impairment significantly increased (p=0.000) with non-use of available eye-care services. The participantôs need for eye-care services was significantly associated with visual impairment.

Refractive error and pathological disorders are significantly associated with visual impairment (pÒ0.00). The prevalence of moderate visual impairment increases with the presence of a refractive error and pathological disorders. The prevalence of visual impairment increases from moderate to severe among participants with pathological disorders. The percentage decreases among participants with refractive error.

4.5.3.2 Multinomial logistic regression for severity of visual impairment

In Table 4.12 the results of multinomial logistic regression analysis are presented. The reference category for the multinomial logistic regression model was set to no visual impairment category. Therefore, the programme estimated the model for moderate visual impairment relative to no visual impairment and a model for severe visual impairment relative to no visual impairment. All the variables that were significantly associated with severity of visual impairment in Table 4.11 were used in the multinomial logistic regression analysis. The odds ratios for risk factors associated with the severity visual impairment were calculated.

- **Model for moderate visual impairment relative to normal vision**

The findings of the multinomial logistic model for moderate visual impairment relative to normal vision are presented in Table 4.12. Moderate visual impairment in the 80+ age category was OR 2.9 (95%CI, 1.1-7.7) more likely when compared to those who are in the 50 to 59 age category. Regarding other age categories, there was no significant association with moderate visual impairment (*p*Ó0.05).

The odds ratio of participants who never went to school having moderate visual impairment was OR 1.8 (95%CI, 0.9-3.7) more likely than those who had high school plus education. Moderate visual impairment was not significantly associated with educational level (*p*>0.05).

Having moderate visual impairment was more likely in participants with refractive error problems than those without refractive error problems OR 73.5 (95%CI, 33.3-162.1). Respondents with pathological disorders were more likely to have moderate visual impairment OR 42.9 (95%CI, 20.3-90.9). The likelihood of having moderate visual impairment was 1.8 more in those who had no need for eye-care services when compared to those who had a need for eye-care services. The odds ratio of having moderate visual impairment was OR 1.9 (95%CI, 1.1-3.5) times more likely in participants who used tobacco products than those who did not. Tobacco use was significantly associated with moderate visual impairment (*p*=0.022).

Table 4.12 Association between risk factors and severity of visual impairment-Multinomial logistic regression

Severity of VI	**Determinants**	**Odds Ratio**	**95% C I**	***P*-value**
Moderate VI	Intercept			.000
	[Age=80+]	**2.9**	**1.1 - 7.7**	**.032**
	[Age=70-79]	1.8	0.8 - 3.9	.131
	[Age=60-69]	1.3	0.6 - 2.8	.466
	[Age=50-59]	Ref.		
	[Education= up to primary level]	1.1	0.5 - 2.1	.900
	[Education= never went to school]	1.8	0.9 - 3.7	.086
	[Education=high School and above]	Ref.		
	[Refractive Error=Yes]	**73.5**	**33.3 - 162.1**	**.000**
	[Refractive Error=No]	Ref.	..	.
	[Pathological =Yes]	**42.9**	**20.3 - 90.9**	**.000**
	[Pathological=No]	Ref.		
	[Hypertension=Yes]	2.6	0.4 - 16.4	.316
	[Hypertension=No]	Ref.		
	[Tobacco Use=Yes]	**1.9**	**1.1 - 3.5**	**.022**
	[Tobacco Use=No]	Ref.		
	[Use of eye-care service=No]	1.1	0.6 - 1.9	.814
	[Use of eye-care service=Yes]	Ref.		
	[Need for eye-care services = Yes]	1.7	0.9 - 3.0	.089
	[Need for eye-care services =No]	Ref.		
Severe VI	Intercept			.000
	[Age=80+]	**4.8**	**1.6 -14.6**	**.005**
	[Age=70-79]	0.9	0.3 - 2.5	.840
	[Age=60-69]	0.9	0.3 - 2.4	.773
	[Age=50-59]	Ref.		
	[Education= up to primary level]	1.6	0.6 - 3.8	.339
	[Education= never went to school]	1.8	0.7 - 4.5	.233
	[Education=high School and above]	Ref.		
	[Refractive Error=Yes]	**9.2**	**2.8 - 30.4**	**.000**
	[Refractive Error=No]	Ref.		.
	[Pathological =Yes]	**90.6**	**32.5 - 253.5**	**.000**
	[Pathological=No]	Ref		
	[Hypertension=Yes]	0.3	0.04 - 1.9	.193
	[Hypertension=No]	Ref.		
	[Tobacco Use=Yes]	1.8	0.9 - 3.9	.125
	[Tobacco Use=No]	. Ref.		
	[Use of eye-care service=No]	1.9	0.9 - 4.1	.080
	[Use of eye-care service=Yes]	Ref.		
	[Need for eye-care services = Yes]	1.1	0.5 - 2.3	.842
	[Need for eye-care services =No]	Ref.		
Goodness-of-fit test	Pearson (0.000) Deviance (1.000)			
Classification table=81.5%				

a. Reference category=normal vision
b. Severe=6/60 vision to total blindness.

- **Model for severe visual impairment relative to normal vision**

The findings of the multinomial logistic model for severe visual impairment relative to no visual impairment are presented in Table 4.12. The risk of having severe visual impairment among the respondents in the 80+ category was 4.8 (95%CI, 1.6-14.6) times more likely than those who were in the 50 to 59 year old category. There was a significant association between age group 80+ and severe visual impairment (p=0.005). There was no significant association between age group 60-69 and 70-79 with severe visual impairment ($pÓ0.05$). The odds of having severe visual impairment in the 60 to 69 and 70-79 age category were less than 1.

Participants having refractive error problems were OR 9.2 (95%CI, 2.8-30.4) more likely to be severely visually impaired than those without refractive error problems. Refractive error was significantly associated with severe visual impairment (pÒ0.05). The odds ratio of those with ocular pathological disorders increased from OR 42.9 (95%CI, 20.3-90.9) in the moderate visual impairment relative to no visual impairment to OR 90.6 (95%CI, 32.5-253.5) in the severe visual impairment relative to no visual impairment. There was a significant association between ocular pathological disorders and severe visual impairment ($pÒ0.000$). There was no significant association between hypertension, the need for eye-care services, tobacco use and severe visual impairment (p>0.05).

In conclusion, in the age 80+ category, refractive error and pathological disorders were significantly associated with all the different degrees of visual impairment. Tobacco use was only significantly associated with moderate visual impairment and not significantly associated with severe visual impairment. All the other risk factors, such as educational level, hypertension and the need for eye-care services, were not significantly associated with both moderate and severe visual impairment (p>0.05).

CHAPTER FIVE

5.1 INTRODUCTION

The aim of this study was to investigate the burden and determinants of blindness and visual impairment amongst the elderly in the Dikgale HDSS, Capricorn district, Limpopo Province, South Africa.

5.2 DISCUSSION.

The prevalence of presenting bilateral visual impairment meeting the criteria in the better eye was 26.4% (186) out of the 704 observed respondents. The majority of the participants had moderate visual impairment, with a similar prevalence in males and females. Many, 278 (39.4%), participants used tobacco products. In agreement with previous studies, cataracts (46.2%) and refractive error (39.8%) continue to be the leading causes of visual impairment, followed by corneal opacifications (6.5 %) and glaucoma (primary open angle glaucoma) with 4.3%.

In the 80+ age category (p=0.03), refractive error (p=0.000), pathological disorders (p=0.000) were significantly associated with all the different degrees of visual impairment. Tobacco use was only significantly associated with moderate visual impairment (p=0.022) and not with severe visual impairment. All the other risk factors, such as educational level, hypertension and the need for eye-care services, were not significantly associated with either moderate or severe visual impairment (p>0.05).

5.2.1 Prevalence and distribution of visual impairment

Visual impairment is a leading, but largely preventable, cause of disability worldwide (Stevens et al., 2013). It is ranked among the top six causes of burden of disease in terms of disability adjusted life in low income, middle income and high income countries (Bastarwrous et al., 2014). Visually impaired individuals, as well as their families, face serious social and economic challenges (Schaftenaar et al., 2014). Globally, the prevalence of visual impairment is 10.4 % (95%CI, 9.5%-12.3%) in older adults (Stevens et

al., 2013). Marmamula et al. (2011), in a study done in fishing communities in South India, reported a prevalence of moderate visual impairment and blindness of 23% and 7% respectively. In sub-Saharan countries, Naidoo et al. (2014) reported a prevalence of 1.3% amongst the people in the 50 years and above age group.

In the present study the prevalence of moderate and severe visual impairment meeting the criteria of the better eye was found to be 18.5 % and 3.8% respectively. This figure is higher than the figure reported in a study done by Oduntan et al. (2003) in the Limpopo Province and the study undertaken by Cockburn et al. (2012) in urban Cape Town, South Africa, which reported 0.73% and 4.9% of visual impairment respectively. Statistics SA reported that an estimated 1.3% of people in South Africa are living with visual impairment (Statistics SA, 2011). Previous studies did not take into account participantôs presenting visual impairment due to refractive error, which contributes a major proportion of causes of visual impairment globally.

The present study used the current definition of visual impairment which is defined as presenting visual acuity (VA) of <6/18 to > or equal to 6/36 and blindness of visual acuity of less than 3/60 (World Health Organisation, 2011). In addition to the criteria used to categorise visual impairment, the high prevalence of blindness in the present study is a reflection of the increasing trend in global blindness, which has increased by 0.6% from 1990 to 2010, due to increased number of people who are aging. The preventable global blindness trend continue to increase even though simple remedies like spectacle correction was supposed to correct uncorrected refractive error which causes 16% of blindness and 46% of visual impairment across all age groups in Indian state of Andhra (Marmamula et al., 2011).

According to Resnikoff et al. (2008), globally, the prevalence of blindness in older adults (50 years and above) is between 0.57% and 0.6% in first world countries like Australia, Brunei Japan, New Zealand and Singapore. In African countries, including South Africa, a prevalence of blindness amongst the 50 and above age group was found to be 9.0% (Resnikoff et al., 2008). Bucher &

Ijsselmuiden (1988), in a study done in the former Gazankulu (now falling within the Limpopo Province) reported a low prevalence of blindness in adults (0.57%). Oduntan et al. (2003) also reported a low prevalence of blindness in South Africa (0.24%) amongst the adults in the Limpopo Province. In the present study the prevalence of blindness was found to be 3.6%, which is similar to the 3.4% found in other developing countries, such as India, Bhutan, North Korea and the Maldives, as reported by Resnikoff et al. (2008). Therefore, the need for the Limpopo Government to provide eye-care services to rural communities in order to curb the burden of visual impairment due to refractive error to the level of 0.57% world standard is of the outmost importance.

Avoidable blindness due to ocular disorders is still one of the most tragic, wasteful and significant global public health problems (Resnikoff, 2008). Healthy eyes and good vision are still important determinants of a populationôs health across the globe (Schaftenaar et al., 2014). Approximately 80% of people who are visually impaired in the developing world suffer from conditions like cataracts and refractive errors, which are avoidable in the sense that their impact on visual impairment and blindness could be prevented (World Health Organisation, 2013). This global figure is similar to the 86.0% prevalence of visual impairment due to both refractive error and cataracts reported in the Dikgale HDSS.

Corneal disorders account for 6.5% of blindness and are the third major cause of visual impairment, with glaucoma in fourth place at 4.3%. Cataracts and refractive error continue to be the leading causes of visual impairment in the Dikgale HDSS, even though they can both be easily corrected with low cost spectacles or surgery. Cockburn et al. (2012) also reported that 79% of the visual impairment found in urban Cape Town, South Africa was due to avoidable causes. According to Mashige and Martin (2011), most people in the developing countries still have avoidable visual impairment because they do not receive eye-care attention due to non-use of available eye-care services. Therefore, intensifying the awareness of available eye-care services

and provision of free or low cost spectacles and cataract surgeries will help curb the burden of visual impairment.

5.2.1.1 Prevalence of visual impairment by gender

According to the World Health Organisation (2011), the risk of visual impairment and blindness is higher in females than males in every region of the world and at all ages. Globally, the prevalence of visual impairment is higher in females than in males (Stevens et al., 2013). In sub-Saharan Africa, Naidoo et al. (2014) reported a 3.8% prevalence of visual impairment for males as compared to 4.2 % for women. Marmamula et al. (2011) reported gender as a significant factor associated with visual impairment ($p<0.05$) due to the fact that males normally do not have a health-care-seeking behaviour as do females. Isipraditt et al. (2014) reported that women had similar prevalence of blindness but higher prevalence of visual impairment when compared to men

In South Africa, Cockburn et al. (2012) reported that being female was associated with increased risk of vision loss OR 1.4 (95%CI, 1.1-1.9). In contrast to the above studies, Soori et al. (2011) and Mabaso and Oduntan (2014), reported that there was no significant difference in visual impairment by gender ($p>0.05$). In the present study, the prevalence of visual impairment was higher amongst males (30.6%) than females (24.8%), but gender was found not to be significantly associated with visual impairment ($p>0.05$).

5.2.2 Prevalence of ocular disorders associated with visual impairment and blindness

Major causes of visual impairment in the world are refractive error (43%) and cataracts (33%), followed by glaucoma, retinopathies, macular degenerations at 2% (World Health Organisation, 2007). Major risk factors include non-ocular risk factors, such as age, gender and socioeconomic status, and ocular risk factors, such as retinopathies, macular degeneration, glaucoma and refractive error (World Health Organisation, 2007). Other risk factors include tobacco use, exposure to ultraviolet (UV) radiation, vitamin A deficiency, high

body mass index, metabolic disorders, environmental factors, poverty and lifestyle (World Health Organisation, 2007).

Generally all over the world, the main causes of visual impairment are not totally different between countries, but differ in their percentage and patterns (Ali and Klalil, 2011). Pascollini and Mariotti (2012) reported cataracts and refractive error as the leading causes of visual impairment globally. Marmamula et al. (2011) also reported cataracts and refractive error as the leading causes of visual impairment, with cataracts contributing to 92.8% of blindness and 77.2% of moderate visual impairment. According to Naidoo et al. (2014), major causes of visual impairment in the sub Saharan Africa are cataracts (35%), unidentifiable causes (33.1%) and refractive error (13.2%). In the present study, major causes of visual impairment were found to be cataracts followed by refractive error, corneal opacifications and glaucoma. However, there were other causes of insignificant number, such as retinitis pigmentosa, retinal afferent pupillary defect, retinopathies, macular defect and amblyopia. The high prevalence of cataracts in this community could be attributed to the participantôs exposure to sunlight and due to aging (Naidoo et al (2014).

5.2.3 Risk factors of blindness and visual impairment

Visual impairment was significantly higher in participants in the older age group, those with pathological disorders, refractive error and in those who used tobacco products. Although these factors were significantly associated with visual impairment, our analysis did not allow us to draw any conclusions about causation and only the risk factors contributing to the prevalence of visual impairment and their statistical relationships were dealt wth. Monthly income, educational status, having hypertension, need, use and knowledge of available eye-care services were not significantly associated with visual impairment.

According to the World Health Organisation (2011), most people with visual impairment and blindness are elderly. Isipraditt et al. (2014), in a study done

in Thailand, reported that the risk of visual impairment and blindness increases significantly with increasing age. In a study done in an urban West African country, Marmamula et al. (2011) reported that visual impairment was significantly higher in older age groups. Budenz et al. (2012) also reported that the risk of visual impairment and blindness increases significantly with increasing age. In South Africa, Cockburn et al. (2012), in a study done in Cape Town, also reported a positive assosciation between age and vision loss, with the 80+ age group having greater risk of developing visual loss than those in the age groups 50-59 (5.1 (95%) 3.5-7.6).

The present study is in agreement with the above studies, finding that the risk of visual impairment increases significantly with age (p<0.05). The odds ratio of having visual impairment in age group 70-79 is OR 1.51 (95%CI, 0.75-3.03) and that in age group 80+ OR 3.76 (95%CI, 1.56-9.04). Marmamula et al. (2011) reported a higher odds ratio of 10.67 (95%CI, 7.26-15.67) and 11.81 (95%CI, 7.08-19.69) for age group 60-69 and 70 and above respectively. Age was also significantly associated with all the degrees (moderate and severe) of visual impairment. In general, across most studies, there is significant increase in the number of people with impaired visual function with increasing age across both moderate and severe visual impairment. Therefore, the elderly must be encouraged to have regular eye examinations in order to detect any pathological conditions before they cause avoidable visual impairment and disability.

In the present study, refractive error was found to be significantly associated with visual impairment (p=0.000). The odds ratio of people with refractive error was found to be OR 73.5 (95%CI, 33.3-162.1) more likely to develop moderate and OR 9.2 (95%CI, 2.8-30.4) more likely to develop severe visual impairment than those without refractive error. Cockburn et al. (2012) also reported refractive error as the leading cause of visual impairment (50%). Lewallen and Courtright (2001) reported that natural refractive error is a significant cause of visual impairment less than 6/18 but better than 3/60 in the better eye, but not a significant cause of blindness in most of the population-based surveys undertaken in Africa. According to Holden and

Resnikoff (2004), the duration of visual impairment due to uncorrected refractive error can account for twice as many blind-persons per year than does cataracts, because of the earlier age of onset of refractive error. In the present study, refractive error was found to be the leading cause of visual impairment. Therefore, advocacy for refractive error correction must be addressed.

Pathological disorders were found to be significantly associated with both moderate OR 42.9 (95%CI, 20.3-90.9) and severe visual impairment OR 90.6 (95%CI, 32.5-253.5) in the present study. The low level of precision could be due to the fact that there were a large number of participants who presented with visual impairment due to pathological disorders and refractive error.

In a study done by Varma et al. (2004) in Los Angeles, a history of ocular diseases was found to be significantly associated with visual impairment OR 3.2 (95%CI, 2.1-4.8). The leading causes of blindness did not change from 1990 to 2010 with cataracts being the most frequent cause of blindness (Jonas et al., 2014). Cockburn et al. (2012) reported a low prevalence of visual impairment (27%) due to cataracts because of the high coverage of cataract surgey in Cape Town, but still found that cataracts is the second leading cause of visual impairment. Bucher & Ijsselmuiden, (1988) reported a 37% prevalence of visual impairment due to cataracts. In the present study cataracts was also found to be the second leading cause of visual impairment (46.2%) and contributed 77.4% to pathological disorders.

The results of the present study show a high prevalence of visual impairment due to cataracts, which is similar to previous studies done in South Africa by Rotchford and Johnson (2002) and Salmon et al. (1993), which reported a prevalence of visual impairment due to cataracts of 50-54% in >40 years group. Therefore, cataracts still remains an important risk factor of visual impairment and the need to further increase the volume and quality of cataract surgery is indicated.

In South Africa, Mabaso and Oduntan (2014) found that smoking was not associated with visual impairment. In contrast, smoking was found to be significantly associated with visual impairment in the present study (p=0.02). Visual impairment was found to be OR 1.90 (95%CI, 1.11-3.25) more likely in those who are smoking than in those not smoking. Chipendo et al. (2012) also found that smoking was one of the predisposing factors in development of eye diseases and was significantly associated with visual impairment. In a study done in Hawaii by Brenton et al. (2015), the odds of smokers developing eye diseases, such as uveitis, was found to be OR 2.33 (95%CI, 1.22-4.45; P=0.01) more likely than in non smokers. Therefore, there is a need to encourage patients to avoid or stop smoking and to also make them aware of the afflications that can develop when they are exposed to smoking.

Chipendo et al. (2012), in a study done in Zimbabwe, found that educational level affected the level of awareness of eye diseases, as those who were not educated did not have sufficient knowledge of the various diseases. In South Africa Cockburn et al. (2012) and Mabaso and Oduntan (2014) also found that the prevalence of visual impairment decreases significantly with an increase in level of education. In agreement with the global trends the present study found a statistically significant association with visual impairment (p<0.05) when calculating p-value for educational level and the odds of having visual impairment increased with a decrease in educational level. But, in general, educational status was not significantly associated with visual impairment and its severity with logistic regression analysis. This could be due to the fact that educated participants are always more knowledgeable regarding eye-care services available to them. The extent of visual impairment for both moderate and severe visual impairment, were also found not to be significantly associated with knowledge of eye care services of the participants.

In the present study there was no significant association between monthly income level and visual impairment. This could be due to the fact that the Mankweng Eye Clinic is situated less than 10km away from the Dikgale HDSS therefore addressing the issue of accessibility of eye-care services by the

participants and lack of infrastructure, which was encountered in other similar studies. In other parts of South Africa, Mabaso and Oduntan (2014) and Cockburn et al. (2012) reported that low economic status (*p*-for-trend <0.001) was significantly associated with visual impairment. Resnikoff et al. (2004) and Pascolini and Mariotti (2012) also reported that the prevalence of visual impairment and blindness is three to four folds higher in low-income countries than in industrialised countries, due to the inequality of access to eye-care services. Awan et al. (2011) further stated that most of the visually impaired populations live in the developing countries where there is lack of basic health infrastructure which is severely deficient in meeting the needs of its people.

Uncontrolled hypertension is one of the risk factors for developing hypertensive retinopathy (Pascolini and Mariotti, 2012). In a study done on Black South African adults by Oduntan et al. (2003), hypertensive retinopathy was reported to be one of the minor causes of monocular and binocular blindness. In the present study, hypertension was not significantly associated with visual impairment (*p*>0.05), even though Alberts et al. (2005), in a study done on Black South Africans, reported that only 15% of women and 7% of men with hypertension used blood pressure medication.

The World Health Organisation (2002) stated that, as the incidence of systemic diseases like diabetes gradually increases; there is the possibility that more individuals will suffer from eye complications which, if not properly managed, may lead to permanent eye damage. In Nigeria, Kyari et al. (2014) reported that people with diabetes were over three times more likely to develop visual impairment than those without diabetes OR 3.2 (95% CI, 1.2-9.3). In South Africa, Mabaso and Oduntan (2014) reported that diabetic retinopathy may be significantly associated with visual impairment and blindness, but the development of diabetes was not significantly associated with the development of visual impairment. In the present study, glucose levels Ó11.1mmol/l was not significantly associated with visual impairment. The presence of diabetes is a well-known risk factor for blindness and visual

impairment because of the high risk of diabetic retinopathy. Therefore, our respondents could be monitoring their diabetes well.

5.3 CONCLUSION AND RECOMMENDATIONS

The present study reported for the first time population-based data on the prevalence and risk factors of visual impairment in an adult population in a rural region of the Limpopo Province, South Africa. The study found a high prevalence of visual impairment and blindness amongst the people over 50 years in Dikgale HDSS Unemployment and lack of education are likely to increase the burden of visual impairment among the participants. Avoidable visual impairment due to refractive error and cataracts is still a major problem globally, followed by corneal diseases and others. The provision of spectacles is an extremely cost effective intervention method, which provides immediate correction of the problem and reduces the associated public health problems like limitation of basic everyday function.

According to Resnikoff et al. (2008), Africa is still the most underserved continent in terms of human resources to treat and manage eye diseases even though it has the highest prevalence of visual impairment. In contrast to the above statement, the Department of Health, Limpopo Province is providing free eye-care services (including cataract surgery) and a free pair of spectacles (to those who need them) to people over 60 years of age. But amidst all these resources there is still a high prevalence of avoidable blindness due to cataracts and refractive error which needs to be tackled by the Department of Health in the Limpopo Province. This might be due to the fact that previous research has shown that availability alone is not sufficient to improve services (Rotchford et al., 2002). Therefore, our future challenge is to significantly decrease the burden of avoidable visual impairment by undertaking community eye-care outreach and screening to make people realise that they need eye-care services or that they are visually impaired. This must be done because there are many participants who perceive themselves to be able to see, even though they are classified as visually impaired. People must be aware that visual impairment/blindness is not a

normal part of life or ageing, but can be corrected or prevented. Better education about the prevention of blindness and visual impairment will help to minimise the incidences of these conditions. Therefore, there is a need for the Provincial Department of Health in the Limpopo Province to embark on intensive eye-care promotion and vision screening campaigns to prevent or reduce the burden of avoidable visual impairment.

5.4 CONTRIBUTIONS OF THE STUDY

Findings of the study established that there is a high prevalence of avoidable visual impairment and blindness among this rural population. The present study reports for the first time population-based data on the prevalence and causes of visual impairment in an adult population in a rural region in Limpopo Province, South Africa.

There is still a paucity of national data regarding blindness and visual impairment in Africa (Reskinoff et al., 2008). South Africa, despite being one of the economic giants in Africa, does not have a national estimate of the prevalence and causes of blindness and visual impairment. Most data used for planning eye-care services have been generated from hospital-based or small focal surveys. When looking at prior studies, like the Tema eye study in Ghana done only on the urban population and the Baltimore study done in Americaôs urban population, the results were used to make conclusions about the state of visual impairment in the whole country. The Dikgale Health and Demographic Surveillance system is a rural representation of the Limpopo Province; therefore, the present study was used to make conclusions about the current state of visual impairment in the Limpopo Province.

5.5 LIMITATIONS OF THE STUDY

Firstly, it would have been best to know the prevalence and causes in all age groups, but the study was done only in the 50 years and above. This decision was made due to the fact that, in recent literature, most of the visually impaired population was found in the 50 and older age groups.

Secondly in our study a higher number of females than males participated due to the fact that life expectancy is higher in women than in men, which this is in agreement with the current national census (Statistics SA, 2011).

Thirdly, the low level of precision in some variables when doing regression analysis could be due to the fact that there were an extremely large number of participants who presented with visual impairment due to pathological disorders and refractive error.

REFERENCES

Abdull MM, Sivasubramanium S, Murthy GV, Gilbert C, Abubaker T, Ezelum C, Rabiu MM. Causes of blindness and visual impairment in Nigeria: the Nigeria National blindness and visual impairment survey. *Investigative Ophthalmology and Visual Science* 2009; 50: 14-20.

Adams AJ, Lovie-Kitchin J. Profile Ian L Bailey. The leader of low vision and father of log MAR system. *Clinical and Experimental Optometry* 2004; 87: 1-5.

Alberts M, Urdal P, Steyn K, Stensvold I, Tverdal A, Nel J, Steyn N. Prevalence of cardiovascular diseases and associated risk factors in a rural black population of South Africa. *European Journal of Cardiovascular Prevention and Rehabilitation* 2005; 12: 347-354.

Ali ABM, Klalil LA. The quality of visual acuity and common causes of low vision in Khartoum. *Khartoum Medical Journal* 2011; 04: 596-602.

Andersen R. Revisiting the behavioural model and access to medical care: Does it matter? *Journal of health and social behaviour* 1995; 36: 1-10.

Ashaye A, Ajuwon A, Adeoti C. Perceptions of blindness and blinding conditions in rural communities. *Journal of the National Medical Association* 2006; 98: 887-893.

Awan ZH, Mahar PS, Memon MS. Blindness and poverty. *Pakistan Journal of Ophthalmology* 2011; 27: 165-170.

Babbie ER, Mouton J. 2007. The Practice of Social Research. 11th edition. Cape Town: Oxford University Press.

Bastawrous A, Burgess PI, Mahdi AM, Kyari Fatima, Burton MJ, Kuper Hannah. Posterior segment eye disease in sub-Saharan Africa: review of

recent population-based studies. *Tropical medicine and international health* 2014; 19: 600-609.

Bhagwan J, Rastogi I, Malik J, Dhull C. Knowledge, attitude and practices regarding cataract surgery among severe cataract cases in Hanyana. *Indian Journal of Community Medicine* 2006; 31: 66-68.

Billy R, Hammond JR, Wooten R, Snodderly M. Cigarette Smoking and Retinal carotenoids: Implications for Age-Related Macular Degeneration. *Vision Res* 1996; 36: 3003-3009.

Bowling A. Research Methods in Health. Investigating health and health services. Second edition, 2002. Open University Press. Buckingham Philadelphia.

Bradley E. Health services research: Expanding the Anderson Model: The role psychosocial factors in long term care use (2002). Web page available at: http://findarticles.com/p/articles/mi-m4149/is-5-37/ai-95105506/print/ tag.

Brenton G, Yuen BA, Vivien M, Tham MD, Erica N, Browne MS, Rachel Weinrib MPH, Durga S, Borkar MD, John V, Parker BS, Uchida MPH, Aleli C, Vinoya BS, Nisha R, Acharya MD Association between Smoking and Uveities: Results from the Pacific Ocular Inflammation Study. *American Journal of Ophthalmology* 2015*;* 122: 1257-1261.

Bucher PJM, Ijsselmuiden CB. Prevalence and causes of blindness in the Northern Transvaal. *British Journal of Ophthalmology* 1988; 72: 721-726.

Budenz DL, Bandi JR, Barton K, Nolan W, Herndon L, Whitesise-de Vos J, Hay-Smith G, Kim H, Tielsch J. Blindness and visual impairment in an urban West African Population: The Tema eye Survey. *Ophthalmology* 2012; 119: 1744-1753.

Bylsma GW, Anhchuong L, Bickol N Mukesh, Taylor HR, McCarty CA. Utilization of Eye Care services by Victorians likely to benefit from eye care. *Clinical Experimental Ophthalmology* 2004; 32: 573-577.

Cano, V. The importance of literature review.2005 [On line].Accessed: April 20 2013 from World Wide Web: *Http://www.uk-student.net/modules/wfsection/article.php?articleid=40.*

Carlson NB, Kurtz D, Heath DA, Hines C. Clinical Procedures for Ocular Examination. Appleton and Lange, 1990. Norwalk, Connecticut/San Mateo, California.

Chandrashekhar T, Bhat H, Pai R, Nair S. Utilization and barriers to cataract surgical services in rural South India, Results from a population based study. *Public Health* 2007; 121: 130-136.

Chipendo GN, January J, Tapera R, Dube B. Community perceptions of eye diseases among 14-40 year olds in Chiota, Zimbabwe. *Educational Research* 2012; 3:780-784.

Clendenin C, Coffey M, Marsh M, West S. Eye care utilization patterns in a rural county in Ireland: implications for service delivery. *British Journal of Ophthalmology* 1997; 81: 972-975.

Crick RP, Khaw TP. A Textbook of Clinical Ophthalomogy: A practical guide to disorders of the eyes and their management. 3rd edition World Scientific, 2003.

Cockburn N, Steven D, Lecuona K, Joubert F, Rogers G, Cook C, Polack S. Prevalence, Causes and Socio-Economic Determinants of Vision Loss in Cape Town, South Africa. *PLoS ONE* 2012; 7: e30718. doi:10.1371/journal.pone.0030718.

Cook C, Kluever H, Mabena L, Limburg H. Rapid assessment of cataract at pension pay points in South Africa. *British Journal of Ophthalmology* 2007; 91: 867-868.

Cook C.D, Knight SE, Criftonï Briggs I. Prevalence and causes of low vision and blindness in Northern KwaZulu-Natal. *South African Medical Journal* 1993; 83: 590-593.

Cook C.D, Stulting A.A. Prevalence and incidence of blindness due to age-related cataract in the rural areas of South Africa. *South African Medical Journal* 1995; 85: 26-27.

Cook I, Alberts M, Burger S, Byass P. All-cause mortality in Dikgale, rural South Africa. *Scandivanian Journal of Public Health 2008*; 36: 753-60.

Daly L.E, Bourke G.J. Interpretation and uses of Medical Statistics 2000. 5th Edition, Blackwell Science.

Dandona L, Dandona R. Revision of visual impairment definitions in the International Statistical Classification of Diseases. *BioMC Medicine* 2006; 4:7. Doi:10.1186/1741-7015-4-7.

Dandona R, Dandona L, Naduvilath TJ, McCarty CA, Rao GN. Utilization of eye care services in an urban population in Southern India: the Aravind Comprehensive Eye Survey. *British Journal of Ophthalmology* 2000; 84: 22-27.

Department of Health Directorate: chronic disease, disabilities and geriatrics 2002. National guideline on prevention of blindness in South Africa.

van Dieren S, Beulens JW, van der Schouw YT, Grobbee DE, Neal B. A global burden of Diabetes and its complications: an emerging pandemic. *European Journal of Cardiovascular Prevalence and Rehabilitation* 2010; 17 Suppl 1:53-8 doi: 1097/01. Hjr. 0000368191.86014.5A.

Farmer J, Iversen L, Campbell NC, Guest C, Chesson R, Deans G, Macdonald J. Rural /Urban differences in accounts of patientsôinitial decision to consult primary care. *Health and Place* 2006; 12: 210-221.

Fletcher AF, Donoghue M, Devaram J, Thulasitaj RD, Scott S, Abdalla M, Shamugham CAK, Murugan B. Low uptake of eye services in rural India. *Arch Ophthalmology* 1999; 117: 1393-1399.

Fotouhi A, Hashemi H, Mohammed K. Eye care utilization patterns in Tehran population: A population based crossï sectional study. *British Journal of Ophthalmology* 2004; 6: 4-12.

Fotouhi A, Hashemi H, Mohammed K, Jalali KH. The prevalence and causes of visual impairment in Tehran: the Tehran eye study. *British Journal of Ophthalmology* 2004; 88: 740-745.

Furtado JM, Lansingh VC, Carter MJ, Milanese MF, Pena BN, Ghersi HA, Bote PL, Nano ME, Silva JC. Causes of Blindness and Visual Impairment in Latin America. *Survey of Ophthalmology* 2012; 57: 149-177.

Garap JN, Sheeladevi S, Shamnna BR, Nirmalan PK, Brian G, Williams C. Blindness and vision impairment in the elderly of Papua New Guinea. *Clinical Experimental Ophthalmology 2006*; 34: 335-41.

Gilbert CE, Shah SP, Jadoon MZ, Bourne R, Dineen B, Khan MA, Johnson GJ, Khan MD. Poverty and blindness in Pakistan: results from the Pakistan national blindness and visual impairment survey. *British Journal of Ophthalmology* 2008; 336: 29-37.

Goldberg DE, Smithen LM, Angelilli A, Freeman WR, Review of HIV-associated retinopathy in the HAART era. *Pubmed* 2005; 25: 633-649.

Grosvenor T. 2007 Primary Health Optometry, 5th edition. London. Butterworth.

Gupta SK, Murthy GVS, Morrison N, Price GM, Dherani M, John N, Fletcher AF, Chakravarthy U. Prevalence of early and late Age-Related Macular Degenerationj in a rural population in Northern India: The INDEYE Feasibility Study. *Investigative Ophthalmology and Visual Science* 2007; 48: 1007-1011.

Holden BA, Resnikoff S. The role of Optometry in vision 2020. *Community Eye Health Journal* 2002; 5: 33-36.

Isipraditt S, Sirimaharaj M, Charukamnoetkanok P, Thononnetra O, Wongsawad W. The first rapid Assessment of Avoidable Blindness (RAAB) in Thailand. *Plos One* 2014, 9:e114245.doi:10.1371/journal.pone.0114245 Accessed on: 17 Dec 2014.

Johnson GJ. The environment and the eye. *Eye* 2004; 18: 1235-1250.

Jonas JB, George R, Asokan R, Flaxman SR, Keeffe J, Leasher J, Naidoo K, Pesudovs K, Price H, Vijaya L, White RA, Reskinoff S, Taylor HR, Richard AW, Wong TY, Resnikoff, Bourne RA. Prevalence and causes of visual loss in Central and South Asia: 1990-2010. *British journal of Ophthalmology* Published online First: [18 February 2014] doi: 10.1136/bjopthalmol-2013-303998.

Kanski JJ. Clinical Ophthalmology: A systemic approach. 1989. 2nd edition. Butterworth international Edition.UK

Kanski JJ. Clinical Ophthalmology:A systemic approach. 2003. 5th edition. Butterwoth international Edition.UK

Katzellenbochen J, Joubert G, Karim S. 1997. Epidemiology. A manual for South Africa. Oxford University Press. South Africa.

Keeffe J, Wein L, McCarty C, Taylor H. Utilization of eye care services by urban and rural Australia. *British journal of Ophthalmology* 2002; 86: 24-27.

Kestelyn PG, Cunningham ET jnr. *Bulletin of World Health Organization* 2001; 79: 208-13.

Kuang TM, Tsai SY, Hsu WM, Cheng CY, Liu JH, Chou P. Correctable visual impairment in an elderly Chinese population in Taiwan: The Shipah Eye Study. *Investigative Ophthalmology and Visual Science* 2007; 48: 1032-1037.

Kyari F, Gudlavalleti MVS, Sivasubramaniam S, Gilbert CE, Abdul MM, Entekume G, Foster A. Prevalence of blindness and visual impairment in

Nigeria: The national blindness and visual impairment survey. *Investigative Ophthalmology and Visual Science* 2009; 50: 2033-2039.

Kyari F, Tafida A, Sivasubramaniam S, Murphy GV, Peto T, Gilbert CE. Prevalence and risk factors for diabetes and diabetic retinopathy: results the Nigera national blindness and visual impairment survey. *Biomed Central Public Health* 2014; 14:1299 doi: 1186/1471-2458-14-1299.

Leasher JL, Lansingh V, Flaxman SR, Jonas JB, Keeffe J, Naidoo K, Wong TY, Price H, Silva JS, White RA, Resnikoff S, Taylor HR, Bourne RRA, on behalf of the Vision Expert Group of the Global Burden of Disease Study. 11 Feb 2014. Doi: 10. 1136/bjophthalmol-2013-304013.

Lewallen S, Courtright P. Blindness in Africa: present situation and future needs. World view. *British Journal of Ophthalmology* 2001; 85: 897-903.

Mabaso R. Blindness and visual impairment among people with Diabetes Mellitus, 40 years and older in the Limpopo province, *South Africa. Unpublished Thesis* 2012.

Mabaso RG, Oduntan OA. Risk factors for visual impairment and blindness amongst black adults diabetics receiving treatment at government health care facilities in Mopani District, Limpopo Province, South Africa. *African Journal of Primary Health Care and Family Medicine*. 2014; 6: 1-8.

Marmamula S, Madala S, Rao GN. Rapid Assessment of Visual Impairment (RAVI) in marine fishing communities in South India-study protocol and main findings. *BioMedical Central Ophthalmology* 2011;11: 26.

Mashige KP, Martin C. Utilization of eye care services by elderly persons in the northern Ethekwini district of KwaZulu-Natal province, South Africa. *African Vision and Eye Health* 2011; 70:175-181.

Mathenge W, Kuper H, Limburg H, Polack S, Onyango O, Nyaga G, Foster A. Rapid Assessment of Avoidable Blindness in Nakuru District, Kenya. *Ophthalmology* 2007; 114: 599-605.

Millodot M. 2009. Dictionary of Optometry and Visual Science, Seventh Edition. Butterworth Heinemann, Elsevier.

Morgan DW, Krejcie RV. 1994. Determining Sample Size for Research Activities. University of Minnesota. United States of America.

Naidoo K, Stephen S, Basanez M, Flexman S, Jonas JB, Keeffe J, Leasher JL, Pesudova K, Price H, Smith JL, Turner HC, White R, Wong TY, Resnikoff S, Taylor HR, Bourne RRA. Prevalence and causes of vision loss in sub-Saharan Africa: 1990-2010. *British Journal of Ophthalmology* 2014; 98: 612-618. doi:10.1136/bjophthalmol-2013-304081

Nakamura Y, Tomidokoro A, Sawaguchi S, Sakai H, Iwase A, Araie M. Prevalence and causes of low vision and blindness in rural Southwest Island of Japan: The Kumejima Study. *Ophthalmology* 2010; 117: 2315-2321.

Nirmalan P,Katz J, Robin AL, Krishnadas R, Ramakrishnan R, Thulasiraj RD, Tielsch J. Utilization of eye care services in rural South India: the Aravind Comprehensive Eye Survey. *British Journal of Ophthalmology* 2004; 88: 1237-1241.

Norwell C, Hiles C. Why every hospital should have an eye liaison officer. *Vision* 2005; 1282: 226-229.

Norwak R. Grzybowski A. Matuszynski M. Causes of Blindness and visual impairment in rural western Sahara: Outcome of Eye camps. *The Internet Journal of Ophthalmology and Visual impairment* 2011; 8:2.

Ntim-Amponsah CT, Amouka WMK, Ofosu-Amaah S, Ewusi RK, Idirisuriya-Khair R, Nyatepe-Coo E, Adu-Darko M. Prevalence of glaucoma in an African population. *Eye* 2004; 18: 491-497.

Ntsoane MD. Oduntan AO. A review of factors influencing the utilization of eye care services. *South African Optometrist* 2010; 69:182-192.

Ntsoane MD. Oduntan AO. Mpolokeng BL. Utilization of eye care services by the rural community residents in the Capricorn district, Limpopo Province, South Africa. *African Journal of Primary Health Care and Family Medicine* 2012; 4:1-7.

Oduntan AO. Global visual impairment. *Epidemiological Implications and Preventions* 2005; 1-2. University of Limpopo press.

Oduntan AO, Nthangeni ME, Ramudzuli MR, Madu SN. Causes and prevalence of low vision and blindness in black South African adults in the Limpopo Province. *South African Optometrist* 2003; 62: 8-15.

Oduntan AO, Raliavhegwa M. An evaluation of the impact of the eye care services delivered to the rural communities in the Mankweng Health sub-district of the Northern Province. *The South African Optometrist* 2001; 60: 71-76.

Oriahi M O. The importance of epidemiology in optometry. *Journal of Nigerian Optometric Association* 2009; 15: 48-51.

Owsley C, McGwin G, Scilley K, Girkin C, Phillips J, Searcey K. Perceived barriers to care and attitudes about vision and eye care: Focus groups with older African Americans and eye care providers. *Investigative Ophthalmology and Visual Science* 2006; 47: 2797-2802.

Palagyi A, Ramke J, du Toit R, Brian G. Eye care in Timor-Leste: a populationï based study of utilization and barriers. *Clinical and Experimental Ophthalmology* 2008; 36: 47-53.

Pararajasegaram R. low vision care, the need to maximize visual potential. *Community Eye Health Journal* 2004; 17:9-20.

Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. *British Journal of Ophthalmology* 2012; 96: 614-618.

Patrick-Ferife G, Ashaye AO, Qureshi BM. Blindness and low vision in adults in Ozoro, a rural community in Delta State, Nigeria. *Nigerian Journal of Medicine* 2005; 14: 390-5.

Pearsall J. Concise Oxford Dictionary 10th edition 1999, Oxford University Press, Great Britain.

Pedro-Egbe CN, Babatunde S. Blindness in Southern Nigeria: a review of available data. *Nigerian Journal of Clinical Practice* 2010; 13: 87-93.

Potter AR. Causes of blindness and visual handicap in the Central African Republic. *British Journal of Ophthalmology* 1991; 75: 326-328.

Ramke J, Palagyi A, Naduvilath T, du Toit R, Brian G. Prevalence and causes of blindness and low vision in Timor-Leste. *British Journal of Ophthalmology* 2007; 91: 1117-1121

Rabiu M, Gudlavalleti M, Gilbert C, Sivasubramaniam S, Kyari F, Abubakar T. Ecological determinants of blindness in Nigeria: The National Blindness and Visual Impairment Survey. *South African Medical Journal* 2011; 101: 53-58.

Rawashdeh KA, Abulaban WY, Madani MV. Causes of blindness among patients in South Jordan. *JRMS* 2006; 13: 23-26.

Resnikoff S, Pascolini D, Etyaâle D, Kocur I, Pararajasegaram R, Pokharel G P, Mariotti S P. Global data on visual impairment in the year 2002. *Bulletin of the World Health Organization* 2004 **82** 844-851.

Resnikoff S, Pascolini D, Etyaâle D, Mariotti S P, Pokharel G P, Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bulletin of the World Health organization* 2008; 86: 1-80.

Richard AI, Tebepah T. Visual status and causes of low vision and blindness among HIV/AIDS patients in Yenagoa, Bayela State, Nigeria. *Journal of AIDS Clinical Research* 2013; 206. Doi10.4172/2/55-6113.1000206.

Robin A, Nirmalayan P, Ramasamy K, Rengappa R, Katz J, Tielsch J, Ravilla D, Friedman M. The utilization of eye care services by persons with Glaucoma in rural South India. *Trans American Ophthalmology Soc* 2004; 102: 47-52.

Rotchford AP, Johnson GJ. Glaucoma in Zulus: a population-based cross-sectional survey in a rula district in South Africa. *Arch Ophthalmology* 120:471-478.

Rotchford AP, Rotchford KM, Mthethwa LP, Johnson GJ. Reason for poor cataract uptake- a qualitative study in rural; South Africa. *Journal of Tropical Medicine and International Health* 2002; 7: 288-292.

Sacharowitz HS. Visual impairment in South Africa: achievements and challenges. *The South African Optometrist* 2005; 64: 139-149.

Salamão SR, Cinoto RW, Berezovsky A, Ujo-Filho A, Mitsuhiro MRKH, Mendieta L, Morales PHA, Pokharel GP, Belfort R, Ellwein LB. Prevalence and causes of vision impairment and blindness in older adults in brazil: The São Paulo Eye Study. *Ophthalmic Epidemology* 2008; 15:167-175.

Salmon JF, Mermoud A, Ivey A, Swanevelder SA, Hoffman M. The prevalence of primary angle closure glaucoma and open glaucoma in Mamre, Western Cape, South Africa. *Arch Ophthalmology* 1993; 111:1263-1269.

Saunders M and Lewis P. *Research Methods for Business Students* 2000. London. Butterworth Publishers.

Saunders W.B. Dorlandôs Pocket medical dictionary 26th Edition 2001. Harthcourt international edition. W.B Saunders and Company Philadelphia.

Saw SM, Gazzard G, Friedman D, Foster PJ, Devereux JG, Wong ML, Seah S. Awareness of Glaucoma and Health beliefs of patients suffering primary acute angle closure. *British Journal of Ophthalmology* 2003; 87: 446-449.

Schaftenaar E, van Gorp ECM, Meenken C, Osterhaus ADME, Remeijer L, Struthers HE, McIntyre JA, Baarsma GS, Verjans GMGM, Peters RPH.

Ocular infections in Sub-Saharan Africa in the context of high HIV prevalence. *Tropical medicine and International Health* 2014; 19: 1003-1014.

Schaumberg D, Christen W, Glynn R, Buring J. Demographic predictors of eye care utilization among women. *Medical Care* 2000 38 638-646.

Schellini SA, Durkin SR, Hoyana E, Hirai F, Cordeiro R, Casson RJ, Selva D, Padovan CR. Prevalence and causes of visual impairment in a Brazillian population: the Botucatu Eye Study. *BMC Ophthalmol* 2009; 9: 8-13.

Seland JH, Vingerling JR, Augood CA, Bentham Graham, Chakravarthy U, deJong PTVM, Rahu M, Soubrane G, Tomazolli L, Topouzis F, Fletcher AE. Visual Impairment and quality of life in the Older European Population, the EUREYE study. *Acta Ophthalmologica* 2011; 89:608-613.

Shahriari H, Izadi S, Rouhani M, Ghasemzadeh F, Maleki A. Prevalence and causes of visual impairment and blindness in Sistan-va-Baluchestan Province, Iran: Zahedan eye Study. *British Journal of Ophthalmology* 2007; 91:579-584.

Silva JC, Bateman JB, Contreras F. Eye disease and care in Latin America and the Caribbean. *Survey of Ophthalmology* 2002; 47: 267-274.

Smith TST, Frick KD, Holden BA, Frickie TR, Naidoo KS. Potential lost productivity from the global burden of uncorrected refractive error. *Bulletin of World Health Organization* 2009; 87: 431-437.

Solberg Y, Rosner M, Belkin M. The association between Cigarette Smoking and Ocular diseases. *Public Health and the Eye* 1998; 42: 535-545.

Soori H, Javadi MA, Rafati N. Prevalence and causes of low vision and blindness in Tehran Province, Iran. *J Pak Med Assoc* 2011; 61: 544-549.

South African Veldtypes. Available at:
www.environment.gov.za/soer/index.html. Accessed on 25 August 2011.

Statistics South Africa. 2011

Stevens GA, White RA, Flaxman SR, Price H, Jonas JB, Keeeffe J, Leasher J, Pesudovs K, Resnikoff S, Taylor H, Bourne RRA. Global prevalence of vision impairment and blindness. Magnitude and Temporal trends, 1990-2010. *Ophthalmology* 2013; 120: 2377-2384.

Tabbara KF. Blindness in the eastern Mediterranean countries. *British Journal of Ophthalmology* 2001; 85: 115-121.

Tabbara KF, Ross-Degnan D. Blindness in Saudi Arabia. *Journal of American Medical Assoc.*1986; 255: 3378-3384.

Thylefors B, Negrel AD, Pararajasegaram R, Dadzie KY. Global Data on Blindness. *Bulletin of World Health Organisation* 1995; 73: 115-121.

Varma R, Ying-Lai M, Klein R, Azen SP. Prevalence and risk indiucators of visual impairment and blindness in Latinos: The Los Angeles eye study. *Ophthalmology* 2004. Available at http: //dx. doi.org/ 10.1016/j. ophthal. 2004.02.002.

Vilas K, Sannapaneni K, Ramaswamy S, Ravi T, Gullapalli R. Barriers to accessing eye care services among visually impaired populations in rural Andhra Pradesh, South India. *Community eye care* 2007; 55: 365-371.

Vision and Hearing. Healthy people 2010. Available at: http://phpartners.org/hp/hearing.html.

West SK. Blindness and visual impairment: Global perspective. Ophthalmology and hearing society, Essentials in Ophthalmology. Available at DOI 10. 1007/978-3-642-36324-5_2. © Springer. VerlagBerlin Heidelberg: 2013.

Whitfield R, Schwab L, Ross-Degnan D, Steinkuller P, Swarwood J. Blindness and eye disease in Kenya: ocular status survey results from the Kenya Rural Blindness Prevention Project. *British Journal of Ophthalmology.* 1990; 74: 333-340.

World Health Organization 2000. Elimination of affordable visual disability due to refractive errors. (WHO/PBL/00.79). Geneva

World Health Organization 2001. Declaration of Helsinki. Ethical principle for medical Research involving human subjects. Bulletin 79 (4) 2001. Available at: http://www.who.int/bulletin/volumes/79/4/07-041210/en/index.html.

World Health Organization Bulletin. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. Available at: http://www.who.int/bulletin/volumes/86/1/07-041210/en/index.html.

World Health Organization 2007. Global Initiative for the Elimination of Avoidable blindness Action Plan 2006-2007. Geneva: Bulletin of World Health Organization.

World Health Organization 2007. Global initiatives fot the elimination of avoidable blindness action plan 2006-2011. GENEVA: Bulletin of World Health Organization

World Health Organization 2008. Fighting non-communible diseases: Africaôs new silent killers. *African Health Monitor* 2008; 88:1-57.

World Health Organization 2008. The World Health Organization STEPwise approach to chronic disease risk factor surveillance Available at: http:// www.who.int/chp/steps

World Health Organization 2009. Priority eye disease. Available at: http://www.who.int/blindness/causes/priority/en/print.html.

World Health Organization 2011. Visual impairment and blindness. Fact sheet N°282.

World Health Organization 2013. Universal Eye Health: A Global Action Plan.

World Health Organization 2013. Visual impairment and blindness. FactsheetN°282.

APPENDIX A: DATA COLLECTING TOOL

Table A1. Data collection record sheet for Optometric Procedures

Name:					ID:			
Age					Contact Phone:			
Gender	F				M			
Occupational history					Highest std passed			
Specs	Yes		No		Action			
Reason for non-use								
VA Dist	Uncorrected				Corrected			
	R		L		R		L	
PVA	R				L			
B/VI pathological	Yes				No			
B/VI	**Yes**				**No**			
	R		**L**		**R**		**L**	
Known causes of B/VI by pt.	**R**				**L**			
Ophthalmoscope	Any abnormality				Type of Abnormality			
	Yes		No					
	R	L	R	L				
Media opacification	Yes		No		Location			
					Cornea	R L		
					Lens		N	IOL	LO
						R			
						L			
	R	L	R	L	Vitreous	R			
						L			
Novissphere	Normal		Abnormal		If Abnormal - Chart			
	R	L	R	L				
Amsler's grid	Normal				If Abnormal - Chart			
	R	L	R	L				
Tonometry	Normal		Abnormal					
	R	L	R	L				
Fundus image number								
Cause of B/VI								

ID=Participant ID, G=Gender, VA=Visual acuity, B=Blindness, VI=Visually Impaired, VF=Visual fields, FI= fundus camera imaging, N=normal lens, IOL=intra ocular implant,
LO= lenticular opacification, CVF= Central visual Fields, R= Right eye, L=Left eye, Pt=Patient

APPENDIX B: QUESTIONNAIRE

QUESTIONNAIRE NUMBER: [ ]

INFORMATION SHEET

QUESTIONNAIRE (ENGLISH AND SEPEDI VERSION)

Burden and Determinants of Blindness and Visual Impairment among the elderly in the Dikgale HDSS, Capricorn District, Limpopo Province, South Africa.

Dinyakišišo tša dithlolo tša bofofu le go se bone gabotse ga batšofadi ba Dikgale HDSS, Sedikodikong sa Capricorn, Profenseng ya Limpopo, Afrika Borwa.

Dear participant

This survey is being conducted in Dikgale Community, Capricorn district of South Africa, to assess the determinants of blindness and visual impairment in Dikgale HDSS. The outcome of this study will assist in guiding our provincial health department to address the distribution and equipping our health facilities with eye care providers where there is a need. Your input in completing this questionnaire is very valuable. It should take you not longer than 15 minutes to complete this questionnaire and your responses will be kept strictly confidential. Your co- operation is greatly appreciated.

Go motšeakarolo

Dinyakišišo di diriwa sedikodikong sa Capricorn, Afrika Borwa, go tšweletša kelo ya tsebo, dikgopolo le mekgwa ya batho ba dinagamagae mabapi le ditirelo tša setšhaba tša mahlo. Dipoelo tša dinyakišišo di tla hlahla kgoro ya maphelo ya profense ya Limpopo go aba le go tlabakela mafelo a maphelo ka didirišwa tša mahlo mo go hlokegago. Dikakanyo tša gago mabapi le dipotšišo tše di tla ba mohola. Ga go a swanela go go tšea metsotso ya go feta e lesomehlano (15) go araba dipotšišo tše, gomme le dikarabo tša gago e tla ba sephiri. Tšhomišano ya gago e lebogwa kudu.

N.B: PLEASE FILL IN THE SPACES AND TICK WHERE APPROPRIATE.

PLEASE USE CAPITAL LETTERS

HLOKOMELA: KA KGOPELO TLATŠA DIKGOBA O BE O SWAYE MO GO SWANETŠEGO.

ŠOMIŠA DIHLAKAKGOLO HLE.

DECLARATION BY FIELDWORKER

I hereby declare that I explained to the respondent that he or she is participating freely in this research. I also explained to the respondent that he or she may stop this interview at any point and that such a decision would not in any way affect them negatively.

I explained to the respondent that the answers he or she will provide during the interview would remain confidential.

é é é é é é ..

Signature of enumerator Date: é é é é é é é ..

BOIKANO BJA MOTŠEIŠA KAROLO

Ke ikana gore ke hlaloseditše motšeakarolo gore o tšea karolo a lokologile mo dinyakišišong tše. Ke mo hlaloseditše le gore a ka emiša go tšea karolo nako efe goba efe ge a rata gomme aka se amege felo.

Ke mo hlaloseditše le gore dipoelo tša dinyakišišo tše ga se tša go hola yena ka boyena a nnoši.

Ke mo hlaloseditše le gore dikarabo tsa gagwe ge a tšea karolo e tlo ba tša sephiri.

é é é é é é é é é ..

Signature of enumerator Letġatġi: é é é é é é é .

CONSENT BY PARTICIPANT

DECLARATION BY PARTICIPANT

I hereby declare that I participating freely in this research. I may stop participating at any point and that such a decision would not in any way affect me.

I fully understand that information that I may provide during the course of the research will remain confidential.

é é é é é é ..

Signature of Participant Date: é é é é é é é ..

BOIKANO BJA MOTŠEA KAROLO

Ke ikana gore ke tšea karolo a lokologile mo dinyakišišong tše. Ke kwesisa gore nka emiša go tšea karolo nako efe goba efe ge ke rata gomme nka se amege felo.

Ke gore dikarabo tsa ka ge ke tšea karolo e tlo ba tša sephiri.

é é é é é é é é é ..

Signature of enumerator Letġatġi: é é é é é é é .

SECTION A: KNOWLEDGE REGARDING EYE CARE SERVICES

KAROLO A: TSEBO KA GA DITIRELO TŠA HLOKOMELO YA MAHLO

A1. How often should a person go for regular eye examination? ***Motho o swanetše go hlahlobiwa mahlo kgafetšakgafetša ka morago ga nako e kakang?***	
1-2 years *1-2 mengwaga*	1
3-4 years *3-4 mengwaga*	2
After every 5 years or more *Ka morago ga mengwaga e mehlano*	3
It is not necessarry to go for regular eye examination *Ga go bohlokwa go hlahlobiwa mahlo kgafetsakgafetsa.*	4

A2. Do you know where you can get eye care services? ***E ka ba o tseba mo go abelwago ditirelo tsa mahlo?***	
Hospital *Sepetlele*	1
Church *Kerekeng*	2
School *Sekolong*	3
Traditional healers *Ngakeng ya setso*	4

A3. Is it necessary to go for regular eye test? **E ka ba go bohlokwa go hlahlobiwa mahlo kgafetsakgafetsa?**	
Yes *Ee*	1
No *Aowa*	2

SECTION B: NEED FOR EYE CARE SERVICES

KAROLO B: NYAKEGO YA DITIRELO TŠA HLOKOMELO YA MAHLO

B4. Have you ever experienced any eye problems? ***Naa nkile wa bolawa ke mahlo?***	
Yes *Ee*	1
No *Aowa*	2

B5. Are you able to see at far? **O kgona go bona gabotse kgole?**	
Yes *Ee*	1
No *Aowa*	2

B6. Are you able to see when reading at near? **O kgona go bona gabotse ge o bala kgauswi?**	
Yes *Ee*	1
No *Aowa*	2

B7. Have you experienced headaches after reading? ***Naa nkile wa opa ke hlogo ge o badile?***	
Yes *Ee*	1
No *Aowa*	2

B8. Have you experienced any itching of the eyes? ***Naa mahlo a hlwa a hlohlona?***	
Yes *Ee*	1
No *Aowa*	2

B9. Have you experienced any tearing of your eyes? ***Naa mahlo a gago a fela a e tswa dikeledi?***	
Yes *Ee*	1
No *Aowa*	2

B10. Have you experienced any discharges from your eyes? **Naa mahlo a gago a fela a e tswa melaka?**	
Yes *Ee*	1
No *Aowa*	2

B11. Are you suffering from the following systemic diseases? **(you can select more than one option)** ***Naa o bolawa ke bolwetši bja mmele go swana le? (kgetha e tee feela)***	
High blood pressure *Madi a magolo*	1
Diabetes Mellitus *Bolwetši bja swikiri*	2
Rheumatoid Arthritis *Bolwetši bja Rumatiki*	3
Others (Please specify) *Tše dingwe (Hlalosa)*	4
Not suffering from any systemic disease *Ga gona bolwetši*	5

SECTION C: UTILIZATION OF EYE CARE SERVICES

TŠHOMIŠO YA DITIRELO TŠA HLOKOMELO YA MAHLO

C12. Have you ever had an eye exam? ***Naa o kile wa hlahlobiwa mahlo?***	
Yes *Ee*	1
No *Aowa*	2

C13. What was the cost of your eye examination? ***O lefile bokae?***	
Free *Mahala*	1
R1-R100	2
R101 and over *R101 le go feta*	3
Never had an eye examination *Ga sa ba waka wa hlahlobiwa mahlo*	4

C14. Where did you have your last eye examination? ***Lefelo le o hlahlobilwego mahlo?***	
Clinic *Kliniking*	1
Hospital *Sepetlele*	2
Private practice *Ngakeng ya poraefete*	3
Never had an eye examination *Ga sa ba waka wa hlahlobiwa mahlo*	4

C15. When was the last time you were examined by an eye doctor ***Ke neng la mafelelo moo o kilego waya hlahlobiwa mahlo ke bahlahlobi ba mahlo?***	
Less than a year *Ka fase ga ngwaga o tee*	1
1 ï 2 years *Mengwaga e 1 – 2*	2
More than 2 years but less than 5 years *Go feta mengwaga e 2 eupša ka fase ga e mehlano*	3
Five or more years *Go feta mengwaga e mehlano*	4
Never had an eye examination *Gasa ba waka wa hlahlobiwa mahlo.*	5

C16. Were you given anything to help with your problem?	
Yes *Ee*	1
No *Aowa*	2
Never had an eye exam *Gasa ba waka wa hlahlobiwa mahlo.*	3
C17. What? ***Eng***	
Medication Dihlare	1
Spectacles Digalase tsa Mahlo	2
Contact lenses Digalase tsa go lokela ka mahlong	3
Never had an eye exam *Gasa ba waka wa hlahlobiwa mahlo.*	4

SECTION D: BARRIERS TO THE USE OF EYE CARE SERVICES

KAROLO B: NYAKEGO YA DITIRELO TŠA HLOKOMELO YA MAHLO

D18. Is there anything preventing you from going for an eye examination? ***Gona le seo se go thibelago gore o seye go hlahlobiwa mahlo?***	
Yes *Ee*	1
No *Aowa*	2
D19. Give reasons for your answer ***Efa mabaka***	

THANK YOU FOR COMPLETING THE QUESTIONNAIRE.

RE LEBOGA GE O KGONNE GO FETOLA DIPOTĠIĠO TĠE

APPENDIX C
MEDICAL RESEARCH ETHICS COMMITTEE APROVAL (MREC)

UNIVERSITY OF LIMPOPO

UNIVERSITY OF LIMPOPO

MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

MEETING:	**05/2012**
PROJECT NUMBER:	**MREC/HS/112/2012: PG**

PROJECT :

Title:	Burden and determinants of blindness and visual impairment among the elderly in the Dikgale HDSS, Capricorn district, Limpopo province, South Africa
Researcher:	Ms MD Ntsoane
Supervisor:	Prof M Oriowo
Co-supervisor:	Prof M Alberts Prof JP van Geertruyden
Department:	Medical Sciences
School:	Health Sciences
Degree:	PhD

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 06 June 2012

PROF N EBRAHIM
DEPUTY CHAIRPERSON MREC

The Medunsa Research Ethics Committee (MREC) for Health Research is registered with the US Department of Health and Human Services as an International Organisation **(IORG0004319)**, as an Institutional Review Board **(IRB00005122)**, and functions under a Federal Wide Assurance **(FWA00009419)**
Expiry date: **11 October 2016**

Note:
i) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.**
ii) **The budget for the research will be considered separately from the protocol.**
PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

PROUDLY SOUTH AFRICAN

APPENDIX D: STATEMENT CONCERNING PATICIPATION IN ARESEARCH PROJECT

UNIVERSITY OF LIMPOPO (Medunsa Campus) ENGLISH CONSENT FORM

Statement concerning participation in a Research Project.

Name of the Study

Burden and determinants of Blindness and Visual Impairment among the elderly in the Dikgale HDSS, Capricorn District, Limpopo Province, South Africa.

I have read the information on */heard the aims and objectives of* the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurized to participate in any way.

I know that photographs / electronic images / sound recordings* will be taken of me. I am aware that this material may be used in scientific publications which will be electronically available throughout the world. I consent to this provided that my name / and hospital number* is / are* not revealed. Regarding images of the face, I understand that it may not be possible to disguise my identity, and I consent to the use of these images*.

I understand that participation in this Study is completely voluntary and that I may withdraw from it at any time and without supplying reasons. This will have no influence on the regular treatment that holds for my condition neither will it influence the care that I receive from my regular doctor.

I know that this Study has been approved by the Medunsa Campus Research and Ethics (MREC), University of Limpopo (Medunsa Campus). I am fully aware that the results of these results of this Study will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I hereby give consent to participate in this Study

…… ……

Name of patient/volunteer Signature of patient or guardian.

…… …… ……

Place. Date. Witness

Statement by the Researcher

I provided verbal and/or written* information regarding this Study
I agree to answer any future questions concerning the Study as best as I am able.
I will adhere to the approved protocol.

…… …… ……

Name of Researcher Signature Date Place

*Delete whatever is not applicable.

TLALELETŠO D

UNIVERSITY OF LIMPOPO (Medunsa Campus)
SEPEDI CONSENT FORM

Setatamente mabapi le go tšea karolo ka go Protšeke ya Dinyakišišo.

Leina la Dinyakišišo

Dinyakišišo tša dithlolo tša bofofu le go se bone gabotse ga batšofadi ba Dikgale HDSS, Sedikodikong sa Capricorn, Profenseng ya Limpopo, Afrika Borwa.

Ke badile/ke kwele ka ga tshedimošo mabapi le *maikemišetšo le morero wa* dinyakišišo tšeo di šišintšwego gomme ke ile ka fiwa monyetla wa go botšiša dipotšišo gomme ka fiwa nako yeo e lekanego gore ke naganišiše ka ga taba ye. Ke tloga ke kwešiša maikemišetšo le morero wa dinyakišišo tše gabotse. Ga se ka gapeletšwa go kgatha tema ka tsela efe goba efe.

Ke a kwešiša gore go kgatha tema Dinyakišišong tše ke ga boithaopo gomme nka tlogela go kgatha tema nakong efe goba efe ntle le gore ke fe mabaka. Se se ka se be le khuetšo efe goba efe go kalafo yaka ya ka mehla ya maemo a ka gape e ka se huetše le ge e ka ba tlhokomelo yeo ke e humanago go ngaka yaka ya ka mehla.

Ke a tseba gore Dinyakišišo tše* di dumeletšwe ke Medunsa Campus Research and Ethics (MREC), Yunibesithi ya Limpopo (Khamphase ya Medunsa) .Ke tseba gabotse gore dipoelo tša Dinyakišišo tše di tla dirišetšwa merero ya saense gomme di ka phatlalatšwa. Ke dumelelana le se, ge fela bosephiri bja ka bo ka tiišetšwa.

Mo ke fa tumelelo ya go kgatha tema Tekong/Dinyakišišong/ Protšekeng *.

.....
Leina la molwetši/ moithaopi Mosaeno wa molwetši goba mohlokomedi.

....
Lefelo. Letšatšikgwedi. Tlhatse

Setatamente ka Monyakišiši

Ke fana ka tshedimošo yeo e ngwadilwego mabapi le Dinyakišišo tše
Ke dumela go araba dipotšišo dife goba dife tša ka moso mabapi le Dinyakišišo ka bokgoni ka moo nka kgonago ka gona.
Ke tla latela melao yeo e dumeletšwego.

....
Leina la Monyakišiši Mosaeno Letšatšikgwedi Lefelo