PREVALENCE AND RISK FACTORS OF MYOPIA AMONG GRADE 8 LEARNERS IN VHEMBE DISTRICT, SOUTH AFRICA

BY

D MATHEBULA

11565239

A MINI-DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH (MPH) IN THE SCHOOL OF HEALTH SCIENCES AT THE UNIVERSITY OF VENDA

SUPERVISOR: DR NS MASHAU

CO- SUPERVISOR: MRS SE TSHIVHASE

2020

DECLARATION

I, ***Daphney Mathebula,*** *hereby declare that the mini-dissertation, titled: "****The prevalence and risk factors of myopia among Grade 8 learners in Vhembe District, South Africa****" for the Master of Public Health degree at the University of Venda, hereby submitted by me, has not been submitted previously for a degree at this or any other university; that it is my own work in design and in execution, and that all reference material contained therein has been duly acknowledged.*

Signature ……**Date**01 July 2020……

Mathebula D

DEDICATION

This research is dedicated to my son, Vangama Mothapo. If I could do it you can do even greater work, my son. To my husband, Pitso Mothapo, this belongs to us both because you were there to support me throughout. Finally to my family, I thank you all for believing in me even when I had given up.

ACKNOWLEDGMENT

Firstly I would like to honour the almighty God for granting me the grace to complete this study. It is God who gave me good health and strength to accomplish this work. I would also like to thank the following people for their contribution:

- My supervisor Dr N.S Mashau, thank you for guiding and supporting me to ensure professionalism in my work.
- My co-supervisor Mrs S.E Tshivhase, I would like to thank you for continuously being there to guide me and dedicating your time to my work.
- My grandmother Chingisa Mphephu Mathebula, I would like to thank you for believing in me throughout, inkomu ntombhi ya Kruger.
- To my mother Christinah Mathebula, when you went to school to obtain your Diploma in nursing at the age of 44 you inspired me to further my studies; and for that, I thank you.
- A special thanks to my husband Mr Pitso Bernard Mothapo, thank you my love for your support and allowing me to use our time for my school work. I love you.
- To my aunt, Ingrith Forget Mathebula, thank you for your encouragement and support
- To my little brother, Ndzivalelo Glen Rikhotso, thank you for your assistance when I needed your IT skills
- I would also like to express my gratitude to all my respondents for your participation, I thank you.
- Lastly, I would like to express my sincere gratitude to Mr V.T Bvuma for proof-reading my research.

LIST OF ACRONYMS AND ABBREVIATIONS

LE: Left Eye

PVA: Pinhole Visual Acuity

RE: Right Eye

UHDC: University Higher Degree Committee

UVA: Unaided Visual Acuity

VA: Visual Acuity

ABSTRACT

Myopia is not a simple refractive error but an eyesight-threatening disorder. The disorder has a great impact on public health and the socio-economic well-being of people, particularly children. The aim of this study was to investigate the prevalence of myopia and the risk factors associated with myopia among Grade 8 learners in Vhembe District, South Africa. A quantitative research approach, using descriptive cross-sectional survey design, was used to investigate the prevalence of myopia and the risk factors associated with the disorder among Grade 8 learners. The schools were selected using purposive sampling, based on those with the highest number of Grade 8 learners. The learners were selected randomly from four High Schools in Vhembe District. The sample size of learners was calculated according to Slovin's formula and a self-administered questionnaire and assessment form was used to collect the data for the study. The validity of the instrument was ensured using face and content validity. To test the reliability of the instruments, a test-retest method was used on 10% of the sample size and the Cronbanch alpha (α) value was 0.74, which showed that the instrument was reliable. Ethical clearance was obtained from the University of Venda Research Ethics Committee and permission to conduct the study was obtained from the Department of Education. Ethical considerations, such as informed consent, protection from harm, right to privacy, as well as anonymity and confidentiality, were observed in this study. Descriptive statistics were used to analyse the data and associations between variables were tested through chi-square. Data was captured and analysed using the Statistical Package for Social Sciences (SPSS), version 25.0. The sample comprised of n= 297, of which 158 (53%) were females and 139 (46.6%) were males. Out of the 297, thirty (10.1%) learners had myopia. Myopia was found to be higher among males (70%) than females (30%). In conclusion, myopia was found to be the most prevalent than other refractive errors. Therefore, this study recommended a practical intervention for myopia prevention through promoting health benefits which are associated with more time doing/engaged in outdoor activities.

Keywords: Learner, Myopia, Prevalence, Risk factors, Refractive error

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF STUDY

Myopia is a significant prevalent disease in children, with increasing rates of progression. Myopia (nearsightedness) occurs when light rays are focused in front of the retina instead of directly on the retina (Peltzer, Phaswana-Mafuya, Arokiasamy, Biritwum, Yawson, Minicuci Williams, Kowal and Chatterji, 2015). Myopia is a vision problem experienced by approximately one-third of the population. It is a condition whereby the eyeball is too long from front to back. As a result, the image of a distant object focuses in front of the retina, instead of directly on it (Peltzer, Phaswana-Mafuya, Arokiasamy, Biritwum, Yawson, Minicuci Williams, Kowal and Chatterji, 2015). Therefore, distant objects appear blurred. Globally there are over 80 million reported cases of myopic children worldwide, which lead to considerable socioeconomic and public health concerns (Rudnicka, Kapetanakis, Wthern, Logan, Gilmartin, Whincup, Cook and Owen (2016). Moreover, High myopia is associated with potentially blinding complications, such as glaucoma, retinal detachment, and myopic macular degeneration (Rudnicka, Kapetanakis, Wthern, Logan, Gilmartin, Whincup, Cook and Owen, 2016).

In 2012 Dong, Liu, Wang, Xu, Yang and Ma (2017) reported that more than 2.3 billion people in the world suffered from poor vision because of corrected and uncorrected refractive error. More studies suggest that more than 640 million people are visually impaired from myopia and they do not have access to corrective treatment such as glasses, contact lenses, or refractive surgery. Estimates in 2013 indicated that uncorrected refractive error accounted for 52.9% of visual impairment worldwide, suggesting that it is a global visual health challenge (Peltzer et. al., 2015). Epidemiological studies have reported differences in the prevalence of refractive error. The reasons for differing estimates include differences in age, race, and ethnicity of the populations studied. Evidence is mounting that myopia is growing around the world, with a recent study estimating that on average, 30% of the world is currently myopic and by 2050, almost 50% will be myopic. This is a staggering 5 billion people (Dolgin, 2015). The hot spots of myopia are East and South East Asia, where countries such as South Korea, Taiwan, Singapore, China and Japan have a prevalence of myopia of 80 to 90 %. However, myopia prevalence is also increasing elsewhere, and the USA has reported a prevalence of 42%, almost doubling in three decades (Holden, Frickie, Wilson, Jong, Naidoo, Sankaridurg, Wong, Naduvilath and Rosnikoff, 2016).

Holden et al., (2016) further stated that the prevalence of myopia varies greatly between different populations and ethnic groups. However, the prevalence rates of myopia in the United States have been reported as 20-50% and as high as 80-90% in some parts of Asia. A study by Wu et al., (2016) found that the majority of the myopic population consists primarily of patients with non-pathologic myopia; approximately 66% of patients with myopia have less than two diopters (D) of myopia and 95% of the myopic patients have less than six diopters.

Myopia usually occurs during school going age (Guggenheim et. al., 2013). Furthermore, myopia is the most common disorder of the eye, which is usually associated with severe eye conditions, such as retinal detachment, neovascularisation, glaucoma and irreversible loss of vision (Foster and Jiang, 2014). Socioeconomic status and lifestyle are reported to be the possible causes of the increasing myopia prevalence. In addition, increased near-work, such as excessive viewing of television, excessive reading and playing video games that children are exposed to, make them prone to reduced visual acuity (Rathod, Raghav and Mittal, 2011). Children with high indoor activities and low outdoor time were found to be two or three times more likely to become myopic than those who spend more time outdoors and less near work (Pan, Ramamurthy and Saw, 2012).

According to Wing and Saw (2016) many East Asian countries are particularly affected, where the prevalence of myopia in schoolchildren exceeds 90% in some regions. Although genetic factors play a role in the development of myopia, the rapid growth in prevalence is likely attributable to environmental and lifestyle factors. Prior studies have demonstrated an association between myopia and near-work activities, such as studying, reading, and screen time among children (Holden et al., 2016). Animal experiments suggest that near work may result in hyperopic defocus of the retina leading to excessive growth of the eye, with resultant myopia (Schaeffel and Feldkaemper, 2015). Additionally, the time spent outdoors has been shown to be protective against myopia, potentially due to light stimulation of retinal dopamine which discourages axial growth. Many studies have confirmed that increasing the time spent outdoors reduces the risk of developing myopia, but the pooled information indicated a 2% reduced odds of myopia for each additional hour of time spent outdoors per week (Wong and Saw, 2016).

There has been much work and investigation into the genetics and inheritance of refractive errors, including myopia. However, there remains much to be learned. It is agreed that there is a genetic and environmental interaction that is involved and our understanding of myopia

inheritance will be better understood. Furthermore, Dong et al. (2017) have attested that the process and progression of myopia follow a typical pattern, with normal vision at a young age, starting around school age a myopic shift and rapid increase in myopia begins, which continues until late teenage years. High myopia is associated with significant increased risks for retinal degeneration and detachment, open angle glaucoma, and cataracts at a young age (Schaeffel and Feldkaemper, 2015). However, these associated conditions have a significant lifetime risk of severe visual impairment, including blindness. Due to the significant risks associated with the development of high myopia, paediatric ophthalmologists have been very interested in the prevention of myopic progression.

Darko-Tarki et al. (2016) propunded that the idea that close visual work might cause or promote myopia has been mooted for many years, and it is supported by the well-documented association between short-sightedness and educational attainment. This relation appears not to be explained by a tendency for myopic individuals to take up academic pursuits as a consequence of their disability, as in longitudinal studies differences in academic performance. Education only became mandatory in Hong Kong in 1979. A recent survey of the local fishing community, most of whom still live and work on their boats in close family groups, revealed that only half of the young adults had been to school (Czepita, Czepita D and Lubinski, 2017), thus the quest to examine the impact of childhood reading on myopia while allowing for feasible genetic differences in vulnerability.

Alrasheed, Naidoo and Clarke-Farr (2016) stated that uncorrected refractive error robs children of their opportunities to education and employment, which could seriously affect their quality of life and productivity, driving them further into poverty. Belete, Anbesse, Tsegayeand Hussen (2016) conducted a study with 595 respondents, 59 (11.9%) were myopic and among them 32 (54.2%) had familial myopia. Factors that were found to be positively linked with myopia were, family history of myopia, the school being private, longer time spent partaking in indoor activities, shorter walking distance, lack of outdoor sport activities and use of visual display units (Belete, Anbesse, Tsegaye and Hussen, 2016).High school students are exposed to excessive near work due to high-performance and study pressures as they prepare for their examinations (Belete, Anbesse, Tsegayeand Hussen, 2016). Respondents who were in private school were almost three times at risk of developing myopia, as compared to those who attend government schools. Furthermore, respondents who had positive family history of myopia were 8 times more likely to develop myopia as compared to those who had no such family history (Belete, Anbesse, Tsegayeand Hussen, 2016).

It is estimated that 225 000 people (both children and adults) in South Africa are blind (Sithole, 2013). Furthermore, about 10% of the children are in need of refractive services and correction (Sithole, 2013). In the urban areas, 60% of the population had access to eye health care, while in the rural areas; only 30% of the population had access to eye health care. The prevalence of myopia and hypermetropia among South African school children was found to be 4.0% and 2.6%, respectively (Alrasheed, Naidoo and Clarke-Farr, 2016).

There are several theories on myopia progression. They include, lag of accommodation, mechanical tension and peripheral refraction (Santodomingo-rubido, 2017). The lag of accommodation theory is based on the hypothesis that high lag of accommodation during near work in myopic eyes causes foveal hyperopic retinal blur that induces an abnormal axial growth of the eye leading to myopia. Santodomingo-Rubido (2017) further suggest that prescribing plus lenses to myopic children for near-work reduces accommodative lag during near-work which in turn decreases hyperopic foveal blur, axial elongation and ultimately myopia progression. Peripheral refraction theory suggests that Lens-induced hyperopic defocus accelerates the axial length growth of the eye in a predictable manner in various species, which then leads to myopia (Santodomingo-Rubido, 2017). In another study, Atchison and Rose´n (2016) suggested that spectacles and contact lenses with excess positive power corresponding to the peripheral field could prevent or slow the progression of myopia.

There are two basic processes believed to rule the relationship between physiological optics and eye growth: genetically pre-programmed signalling and blur feedback (Hung, Mahadas and Mohammad, 2016).There are two factors affecting eye growth. The first one is unregulated eye growth, where blur feedback is proved ineffective, as in the case of form deprivation. Therefore, there is only genetically pre-programmed eye growth, generally resulting in myopia (Hung, Mahadas and Mohammad, 2016).The second one is controled eye growth, wherein blur feedback regulation demonstrates the emmetropization process, with abnormally excessive or reduced eye growth, leading to myopia and hyperopia respectively (Hung, Mahadas and Mohammad, 2016). Sithole (2014) discovered that due to absence of policies on eye health promotion, there is no inventiveness for eye health promotion and only normal vision screenings are done using the guidelines given by WHO.

1.2 PROBLEM STATEMENT

During school screening in schools around Malamulele by Malamulele Hospital Optometrists, it was discovered that many children reach their high school level without having had an eye examination. Many of them reported experiencing difficulties taking notes from the board, especially when sitting in the middle row or at the back in class. According to Sewunet, Aredo and Gedefew (2014), special attention should be given to school age because refractive error begins at this age.

There are 45 high schools in the Malamulele area. Furthermore, Malamulele Hospital has three Optometrists, who conduct school visits three times a month, which allows for one school per visit and only primary schools. Primary Health Care (PHC) nurses conduct screenings at primary schools on a daily basis but high schools have never been screened before as the Department of Health was more concerned with primary schools. According to the Integrated School Health Programme 4th draft (2012), all children should be screened after 8 years in full time education; that is in Grade 8.Therefore, this study aimed at investigating the prevalence and risk factors of Myopia among grade 8 learners in Vhembe District. According the statistics in Malamulele Hospital, in all the children who had refractive error in 2016, 37% were myopic. In 2017 and 2018, the prevalence of myopia was at 40% for both years. Lam, Lam, Cheng, Chan, (2012) indicated that myopia incidence increases with age. However, the staffs in Malamulele Hospital only manages to screen primary school children, which means many children go through their high school life without having had their eyes checked.

1.3 RATIONALE FOR THE STUDY

There are no known studies which have been conducted on the prevalence and risk indicators of myopia amongst grade 8 learners in Vhembe District. As myopia is a condition of blurred distance vision, it becomes a challenge for school children to take notes in class because most of these schools still use chalkboards at a distance of six meters or more to write notes. A substantial amount of research has been done to determine the aetiology of myopia and techniques to prevent myopia and ways to treat myopia. However, little has been done to identify the prevalence and risk factors. According to the Integrated School Health Policy (2012), children in the senior phase should also be screened for vision.

1.4 SIGNIFICANCE OF THE STUDY

The Department of Health and the Department of Education may benefit from the outcome of this study, in planning and enhancing the eye care services, in order to prevent blindness in schools. Children may also benefit from visual correction, thus improving their school performance. The findings of this study may also provide useful information for future Myopia researches.

1.5 AIM OF THE STUDY

The aim of this study was to investigate the prevalence of myopia and the risk factors associated with it among Grade 8 learners in Vhembe District.

1.6 OBJECTIVES

The objectives of this study were to:

- Determine the prevalence of myopia among Grade 8 learners in, Vhembe District.
- Identify the demographic factors associated with myopia among Grade 8 learners in, Vhembe District
- Describe the Socio-economic factors associated with myopia among Grade 8 learners in, Vhembe District.
- Describe the environmental factors associated with myopia

1.7 RESEARCH QUESTIONS

Research questions are questions that researchers ask themselves about what they need to find out in the area of their study (Sithole, 2014).

The research questions in this study were:

- What is the prevalence of myopia among Grade 8 learners in Vhembe District?
- Are there any factors that are positively linked with myopia among Grade 8 learners in Vhembe District?
- Are there any negative impacts that myopia has on Grade 8 learners in Vhembe District?

1.8 DEFINITIONS OF CONCEPTS

Learner: A learner is a person who is obtaining experience that causes effect on their behaviour (De Houwer, Barnes-Holmes and Moors, 2013).In this study learner refers to a Grade 8 pupil.

Myopia: Myopia is a refractive error, where in the eye is unable to refract light properly resulting in blurred distance vision (Boyd, 2013). In this study myopia refers to refractive error with spherical power of -0.50 D or greater.

Prevalence: Is the frequency in which a disease or other conditions occur in a given population at a certain time (Szklo and Nieto, 2014). Prevalence in this study refers to the proportion of the occurrence of myopia amongst high school children.

Risk factors: A risk factor is a variable which is linked to increased risk of disease (Boyd, 2013). In this study, risk factors were anything that increase the risk or susceptibility of myopia.

Refractive error: Is a condition whereby the contour of the eye causes light rays not to focus correctly from the object to the retinal plane (Williams, Verhoeven, Cumber, Bertelsen, Wolfram, Buitendijk, Hofman, Van Duij, Vingerling, Kuijpers and Höhn, 2015). In this study refractive error is Visual Acuity of 6/9 or more.

1.9 OUTLINE OF THE MINI-DISSERTATION

This study is divided into six chapters as follows:

Chapter 1: Outlines the introduction, background of the study, problem statement, rationale of the study, significance of the study, the aim, the objectives as well as definitions of concepts.

Chapter 2: Presents literature review from different sources, including previous studies conducted in other countries. The discussion is based on the study objectives. It highlighted the types of myopia and the prevalence of myopia. The chapter also presents the risk factors associated with myopia such as: age, environmental factors, genetic factors and socio-

economic factors. The impact of myopia and management of myopia is also elaborated in this chapter.

Chapter 3: Provides a detailed description of the research methods used in the study, including, research design, study setting, study population, sampling methods and sampling procedure. Data collection process, analysis and ethical considerations are also explained in detail.

Chapter 4: Outlines the results of the study which are presented in tables and charts.

Chapter 5: Provides a detailed discussion of the study results which are also supported by the literature.

Chapter 6: Provides the conclusions and recommendations of the study.

1.10 SUMMARY

Chapter 1 provided the introduction about the prevalence and the risk factors of myopia. The chapter also indicated in details the problem statement, rationale of the study, its significance as well as the aim and objectives of this study. The concepts used were also defined.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this study a review of literature on myopia burden from a global perspective to the local perspective is presented. However, given the broadness of the subject “myopia”, specific literature review will focus on prevalence, risk and demographic factors that are associated with it.

2.2 REFRACTIVE ERROR

Refractive error occurs when the eye fails to bring parallel light (distant objects) to focus on the retina. There are four types of refractive error; namely, myopia, presbyopia hypermetropia and astigmatism (Williams et al., 2015). According to the World Health Organization as presented in the work of Naidoo et al. (2016), the following briefs were provided;

- Myopia (near-sightedness): difficulty in seeing distant objects clearly.
- Hyperopia (farsightedness): difficulty in seeing close objects clearly.
- Astigmatism: distorted vision resulting from an irregularly curved cornea, the clear covering of the eyeball.
- Presbyopia: which leads to difficulty in reading or seeing at arm's length, it is linked to ageing and occurs almost universally

Refractive errors cannot be prevented, but they can be diagnosed through an eye examination and treated with corrective glasses, contact lenses or refractive surgery. If corrected in time and by eye-care professionals, they do not disturb the full development of good visual function (Williams et al., 2016). Correction is provided in different forms, according to the defect, the age of the person, and the requirements in terms of work of activity performed. WHO (2016) estimates that 153 million people worldwide live with visual impairment due to uncorrected refractive errors. This figure does not include the people living with uncorrected presbyopia, which is likely to be quite significant, according to some early evidence.

2.3 TYPES OF MYOPIA

Myopia is a condition whereby instead of light being focused on the retina, it is focussed in front of the retina as a result of excessive refraction at the cornea or lens, or an increased length of the eye (Williams, Verhoeven, Cumber, Bertelsen et al., 2015).

There are three categories of myopia:

- Refractory myopia: this is myopia caused by an error in optical power of the cornea or the lens or combination (Williams, Verhoeven, Cumber, Bertelsen et al., 2015).
- Pathological myopia: It is the presence of myopic maculopathy (Ohno-Matsui, 2016).
- Neurological myopia: it is myopia which is caused by uncorrected refractive error (Hamm, Black, Dai and Thompson, 2014).

Myopia has been associated with education, near work, urbanization, prenatal factors, socioeconomic status, cognitive ability, season of birth, light, and time spent outdoors. One of the strongest and most replicated risk factors is educational attainment. In fact, and there is some evidence of interaction between genetic factors and education, influencing the risk of myopia (Jonas et al., 2016). Thus, the increased levels of higher education over the 20th century might be a causative factor, or be a marker of a causative factor for increasing myopia prevalence. Myopia has been strongly associated with education, and studies that have explored a simple 3-tier classification of educational level have revealed that increasing the educational level has a strong effect, with myopia twice as common in those achieving a higher education compared with respondents leaving school before the age of 16 years (Mountjoy et al., 2018). This interesting association may reflect a number of factors: greater near work activities with more education and less time in outdoor light, shared genetic factors underlying myopia and intelligence, or factors related to educational opportunity, such as socioeconomic status or maternal nutrition.

2.4 PREVALENCE OF MYOPIA

Evidence is mounting that myopia is growing around the world, with a recent study estimating that on average 30% of the world is currently myopic and by 2050, almost 50% will be myopic, that is a staggering 5 billion people (Mc Cullough et al., 2016). The hot-spots of myopia are East and South East Asia, where countries such as South Korea, Taiwan, Singapore, China and Japan have a prevalence of myopia of 80 to 90% (Jonas et al., 2016).

However, myopia prevalence is also rising in other countries and the USA has reported a prevalence of 42%, almost doubling in three decades.

Many recent cross-sectional studies have reported a considerable variation in the prevalence of myopia among children of different ethnic backgrounds, different locations, and different age. Czepita, Czepita D and Lubinski (2017) confirmed that recent population-based cross-sectional study on preschool American children aged 6–72 months reported a myopia prevalence of 1.2% in non-Hispanic whites; 3.7% in Hispanics; 3.98% in Asians, and 6.6% in African-Americans. Furthermore, greater difference in the prevalence of myopia was found in older school-aged children of different ethnicity. These variations in the prevalence of myopia in children of different geographical areas have also been widely reported and considerable regional difference exists from country to country, even within the same geographical area. Hashemi et al (2016) concurred that prevalence rates in East Asian and Southeast Asian countries were generally higher than in other parts of the world. Comparatively, much higher prevalence rates of myopia were reported from recent studies on schoolchildren of similar age in large metropolitan cities in southern China: 38.1% in Guangzhou and 36.7% in Hong Kong (Chen et al., 2018). The conclusion from these observations was that, myopia seems to be more prevalent among young schoolchildren in Singapore than in southern China.

The data available detailing the prevalence of myopia in adults indicated that prevalence rates were found to vary with age, owing to the relative scarcity of data from large-scale cohort studies. A more precise statement might be that the prevalence rates of myopia in older adults are generally lower than in younger adults (Willaims, et al., 2015). Another large-scale population-based study in urban Americans aged 40 years or above also showed an apparent decline in the prevalence of myopia, with increased age in females of different ethnicity and white males. However, a bimodal pattern was observed in the prevalence of myopia among African-Americans of different age, with the peak prevalence rates being found in individuals aged 40–49 years as well as 80 years or above (Naidoo et al., 2016). However it is still debatable whether there is age-related variation in the prevalence of myopia, as widely attested.

In a cross-sectional study in Australian children, the prevalence of myopia was found to be 42.7% in 12 year old and 59.1% in 17 year olds, while in European Caucasian children, it was found to be 8.3% and 17.7% respectively (Foster and Jiang, 2014). In rural Northern China a prevalence of 16.2% was reported in children between 5 and 15 years.

Furthermore, in Southern China in Guangzhou and Hong Kong myopia was found to have a prevalence of 38.1% and 36.7% respectively. Foster and Jiang (2014), conducted a study among school children, aged 7-17 years and found myopia prevalence of 5.8%.

According to a review of five nationwide prevalence surveys carried out in Taiwan between 1983 and 2000, the prevalence of myopia steadily and significantly increased among children aged from 7–18 years (Ding et al., 2017). Furthermore, the magnitude of increase in prevalence over the 17 years varied between 14% (for children aged between 16 and 18 years) and 26% (for 7-year-old children). A similar trend was reported in another review of change in myopia prevalence over 30 years in the United States between 1971 and 2004, in which among all age groups in which the prevalence of myopia was shown to be significantly increased over three decades, the prevalence of myopia in schoolchildren aged 12–17 years increased from 12.0% (between 1971 and 1972) to 31.2% (Mountjoy et al.2018). A cross-sectional study over two generations of Singaporean Indians, aged above 40 years revealed a prevalence of both myopia and high myopia in the first-generation immigrants. It was very much lower than in the second-generation immigrants (Ding et al., 2017). In Ethiopia, Kedir and Girma (2014) found a myopia prevalence rate of 2.6 % in their study conducted among school children in Goro district, Gurage zone, Ethiopia. In Iraq, 58% myopia prevalence was found by Salih (2018) when he conducted a study among children in the El-Mustansiriyah region. The prevalence of myopia and myopic astigmatism were found to be 5.8% and 5.4% respectively in a study at Qassim Province, Saudi Arabia (Aldebasi, 2014).

2.5 RISK FACTORS OF MYOPIA

Myopia is one of the most common problems of the eye. Its prevalence is also increasing seriously in East Asia's fast developing economies, such as China. However, environmental risk factors related to socioeconomic status and lifestyle have been identified, and they seem to be strongly associated with these changes. Evidence has also been accumulated over the past decade with regard to the molecular biological mechanisms that determine refractive error, putting further weight to the theory that myopia is the result of a complicated interaction between genetic predisposition and environmental exposures, as well as other factors to be discussed in this section.

2.5.1 Age

Previous studies have indicated that age was is the strongest independent factor for myopia progression in different cohorts, suggesting that younger children, particularly those 6 to 7 years old, were at risk of faster progression than older children, regardless of other characteristics (Park, Hong and Park, 2016). Therefore, the younger the age, the higher the myopia progression, as well as the amount of myopia at 3 years, despite the general similarity of baseline myopia across age. Similarly, Houn et al. (2016) concurred that change in axial length is also associated with age; thus, reinforcing the importance of age as a factor in myopia progression and related eye growth among children who were included in the Correction of Myopia Evaluation Trial (COMET). These observations suggest that children with significant myopia at a young age should be monitored closely for progression, and the need for prescription changes. Thus the myopia that is already present in children aged 6 or 7 years may be a different type from the myopia that occurs at ages 8 years and older (for example they are more likely to have a genetic basis, more rapidly progressing, more likely to be at increased risk of high myopia).

The COMMET study indicated that an alternative possibility was that the younger children simply might be at an early stage of myopization when rapid progression is most likely to occur, while the older children had reached a later phase in which their myopia was beginning to stabilize (Houn et al., 2016). In addition, multiple regression models, evaluating age and baseline myopia as continuous variables (instead of categorical), both remained as significant predictors of progression An issue to consider is the similarity of baseline myopia across baseline age groups despite the role of age in myopia progression. The similarity of baseline myopia across age groups provides an opportunity to evaluate the independent effect of age, while controlling for baseline myopia. These assertions support the importance of age as a risk factor for progression regardless of the level of baseline myopia and the role of age, as well as the amount of myopia at the time of stabilization, will continue to be examined with additional follow-up (Naito et al., 2016).

2.5.2 Environmental factors

Spending more time outdoors has also been found to be protective against myopia (Sherwin and Mackey, 2013). Near-work activities, such as reading, computer use, writing, and playing video games, have been suggested to be possible causes for the remarkable increase in the prevalence of myopia (Foster and Jiang, 2014). Foster and Jiand (2014) who also conducted a study on rural Chinese children aged around 15 years, found no

association between time spent either outdoors or on near activities after adjustment for age, gender, and parental education. Near-work activities, such as reading, writing, computer use, and playing video games, have been suggested to be possibly responsible for the remarkable increase in the prevalence of myopia as well as increased odds for myopia.

However, there have also been some studies reporting a weak or absent association between a heavier load of near work and the prevalence or incidence of myopia, especially early myopia. A cohort study in Australian schoolchildren showed that those with incident myopia performed significantly more near work (Galvis et al., 2018). Outdoor activities, whether as a potential prophylactic measure or as a possible risk factor, has given rise to considerable interest. However, it is still not clear whether these activities can help prevent the onset and progression of myopia, with several recent epidemiological studies (Chen et al., 2018) suggesting that more time spent outdoors might reduce the prevalence of myopia.

2.5.3 Genetic factors

The parental history of myopia is also a significant determinant of myopia (O'Donoghue, Kapetanankis, McClelland, Logan, Owen, Saunders and Rudnicka, 2015). For example, high myopia has been associated with 18p11.3 (MYP2), 12q21 to 23 (MYP3) and 17q21 to 22 (MYP5) chromosomes (Klein N.d). Furthermore, considerably higher probability of myopia were found in children of East Asian than those of European Caucasians in the same population, whereas increased perfomance of near work was not significantly associated with myopia when factors including parental myopia, demographics, and outdoor activities were adjusted (Foster and Jiang, 2014). The development of myopia can also be associated with abnormal visual experiences at an early age, such as congenital cataracts, corneal opacities and other eye conditions (Foster and Jiang, 2014).

According to Klein (n.d.) in studies amongst school children in Jordan and in Oman, children with myopic parents were also found to be myopic, and the risk of myopia in these children increased with increasing number of myopic parents. In the same studies, the risk of myopia was found to increase in children having myopic siblings. Myopia appears to be more frequently seen in children with myopic parents, Williams et al (2015) reported that the proportions of myopia were varied from lower in schoolchildren aged 13 years whose parents were emmetropic and it was higher in children with one myopic parent, and in children whose parents were myopic. A similar association between parental myopia and the prevalence of myopia was found after adjusting for environmental and demographic factors in another population of 12-year-old schoolchildren in Australia (Holden et al., 2016).

In this case, the children with two myopic parents were also found to have most negative spherical equivalent refraction and the longest axial length, as well as considerably higher chance of myopia were found in children of East Asian than those of European Caucasians in the same population, whereas increased performance of near work was not significantly associated with the chance of myopia when factors including parental myopia, demographics, and outdoor activities, were adjusted for (Darko-Takyi, 2016).

A study by Chen et al. (2018) also revealed that myopic Chinese children aged 5–16 years, with a stronger parental history of myopia also had more myopic spherical equivalent refraction and were less hyperopic before the onset of myopia. Contrary to the findings in Australian children, a stronger parental history of myopia was not associated with longer axial length but was notably associated with more rapid eye growth and myopic shift in refraction over time. Another study in Guangzhou, China showed the existence but small impact of parental myopia on the prevalence of myopia in 15-year-old children (Ding et al., 2017). In Comparison with children with no myopic parents, those with one myopic parent are twice as likely to be myopic, and those with two myopic parents are three times more likely to be myopic themselves. Although more severe parental myopia results in increased risk of myopia in children, the effect of parental myopia on high myopia in children remains undetermined.

2.5.4 Socio-economic factors

Population-based prevalence studies have revealed increased prevalence of myopia in Singaporeans, who had higher levels of education, better housing, higher individual monthly income and occupations associated with near-work after adjusting for age and gender (Wong and Saw, 2016). Myopic children were also found to have a stronger parental history of myopia in families with higher parental levels of education, higher income, and professional occupations. It has also been reported in Singapore and Korea that the increased prevalence of Myopia was linked with high income, high levels of education and better housing (Foster and Jiang, 2014). In the North India, the prevalence of myopia was 13.1%.

A study conducted by Grzybowski et al. (2020) found that myopia was more common among children with higher socioeconomic status (SES) and among private school students, compared to governmental school pupils and presumably children in private schools spent more time at school, compared to children in public schools. Government school children

also spend more time reading and writing at home, with significantly more pressure and a greater likelihood of extra classes. It is therefore a fact that studying and reading for over 5 hours daily, watching television for over 2 hours daily, and playing video/mobile games were also significantly associated with myopia.

A plausible hypothesis would be that children from higher SES families and private schools would be getting more intensive education, as within the study children from private schools spent more time reading at home than those from government schools. However on the contrary, a Dutch study of a multi-ethnic cohort of 6-year-old children, revealing a significant influence of socioeconomic factors on the prevalence of myopia among children of non-European descent, with children from low maternal education, low family income, being more likely to be myopic (Czepita, Czepita and Lubinski, 2017). However, children from families with a non-European ethnic background, like those in private schools in North India, spent less time outdoors, which therefore brings in the aspect of outdoor time, as discussed earlier on. Congdon, Burnett and Frick, (2019) found that population-based studies show associations between myopia and higher socioeconomic status and greater levels of educational attainment. High prevalence and progression rates of myopia have been reported in individuals in visually intensive occupations such as clinical microscopists, carpet weavers and visual display workers.

Within the context of the myopization processs, education, socioeconomic status, and occupation are generally considered to be indirect surrogates for more proximal risk factors, such as near-work visual demands. Studies on the effect of reading have attempted to show a more direct relationship between myopia and near-work activity, and children with myopia spent more time studying, reading, and less time playing sports than children without myopia (Schaeffel and Feldkaemper, 2015). The current ubiquity of technologies such as computers, cellular and smart phones, as well as gaming devices have added a layer of complexity to the near-work question. Indeed, it could be argued that the recent increase in myopia prevalence in East Asia reported in some studies may be the result of a steady rise in the use of modern electronic devices over the past three decades (Ding et al., 2017). Nevertheless, a link between the usage of electronic devices and myopia development has yet to be convincingly proven and future studies should attempt to confirm and quantify this relationship.

2.6 IMPACT OF MYOPIA

Myopia, as the ‘most common eye condition', has been shown to have diverse medical, social, and financial impacts. Uncorrected myopia has been shown to be a major cause of visual impairment and it also compromise the quality of life. The unfavourable impacts from myopia may also be seen socioeconomically, considering the loss of productivity owing to visual impairment caused by myopia, the cost of treatment for comorbidities of myopia, and the cost of various ways of correction (Congdon, Burnett and Frick, 2019).

According to a most recent report published by the World Health Organization (WHO, 2017), the estimated loss in global gross domestic product resulting from distance vision impairment caused by uncorrected refractive error was US$202 billion annually, a much increase over two decades compared with the statistics reported previously and another regional cross-sectional investigation revealed substantial financial burden for myopic individuals in Singapore. Individuals with high myopia were reported to have notably lower vision-related quality of life than those with none, mild, or moderate myopes. The vision-related quality of life in those with high myopia could even drop down close to that of patients with severe corneal pathologies. Macular degeneration due to myopia was linked with another $6 billion of possible productivity loss, and the greatest utter economic burden was experienced in Asia. There are very few economic assessment of myopia correction and no economic assessment of myopia prevention. However, disability weights have been used to estimate possible productivity loss as a proportion of the gross domestic product (GDP) per person.

2.7 MANAGEMENT OF MYOPIA

Due to the many problems arising because of traditional treatment protocols, a new option was introduced in the management of myopia, named laser in-situ keratomileusis (LASIK) (Taqi and Saeed 2016). Early stage interventions to prevent early-onset myopia, which includes increased time outdoors, was found to be protective and decreased the onset of myopia. Several possible mechanisms were postulated for the protective mechanism, and include: high illuminance level of light and pupillary miosis, resulting in less image blur and peripheral hyperopic defocus (Naidoo et al., 2018). Another risk factor found important was excessive near work, although difficult to intervene, as near work and educational success are linked. Little time spent on near-work may prevent or delay onset of myopia, while high and low doses of atropine (1% to 0.1%) were found effective.

However high-dose atropine was associated with loss of cycloplegia and photophobia, as well as a rebound of myopia on discontinuation. On the other hand, low-dose atropine is associated with fewer side effects and no rebound. However, its efficacy remains uncertain (Williams et al., 2015). Contact lenses with added myopic defocus have been shown to be promising in clinical trials, and similarly, orthokeratology was also found to moderate the effects on axial length as compared to single vision spectacles.

More recent studies have directed their attention to sclera and collagen, to counteract the progression of myopia to high myopia or pathological myopia. Scleral cross-linking techniques to reinforce sclera using chemicals, activated by visible light or non-light activated chemicals, are being experimented with a hope to increase scleral tissue stiffness.

2.8 SUMMARY

This chapter outlined the literature on myopia. Myopia has been found to be high among school children. However, most studies showed that females are more myopic than males. When it comes to daily activities, outdoor activities have been found to reduce myopia. The next chapter outlines the methodology of this study.

CHAPTER 3: RESEARCH METHODS

3.1 INTRODUCTION

In this chapter, the study setting, research design as well as research methods, are discussed. Details on the study setting, the study population, the sampling methods and the sampling procedure are also explained. The chapter also explains the aspects of data collection, the data collection instrument, the reason for choosing the instrument and the processes involved.

3.2 RESEARCH DESIGN

Robinson (2014) contends that research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. This study adopted a quantitative research approach because the researcher was counting, measuring and analysing data statistically.

The study also used a cross-sectional survey design because the researcher collected data at one point in time. In this study the cross-sectional survey investigated the prevalence and the risk factors associated with myopia among grade 8 learners.

3.3 STUDY SETTING

The study was conducted in Malamulele under the Collins Chabane Local Municipality, which is one of the five (5) local municipalities in the Vhembe District. Malamulele is situated 41 km away from Thohoyandou, 243 km from Polokwane (the capital of Limpopo Province), 453 km from Pretoria and 508 km from Johannesburg. About 93.7% of the population are Xitsonga-speaking people, 1.7% is Tshivenda-speaking and 4.6% speak other languages. There are about 120 villages in Malamulele, with 45 high schools. About 43 of the schools are public high schools and only 2 are private high schools

Vhembe District is relatively poor in terms of resources, compared to other districts within the province. This is because it is dominated by rural land, while most of the inhabitants are farm labourers and public service employees.

Furthermore, the majority of the households (52.6%) have an estimated income of between R2400 and R6000 per annum, which is below the poverty line.

School health services are conducted on a daily basis by the PHC nurses. The PHC covers primary schools and focuses on general health. Optometrists from Malamulele Hospital also conduct vision screening at schools every Friday, screening Grade 1 learners.

There is only one (1) hospital in Malamulele, with 19 clinics (www.dhsd.limpopo.gov.za). At the hospital there are only 3 Optometrists who service all the clinics and the hospital. Private Optometrists are about five (5). There are too few Optometrists to cover the entire population. Furthermore, there are four (4) circuits of Education in Malamulele; namely, Malamulele Central, Malamulele West, Malamulele North and Malamulele North-East.

3.4 STUDY POPULATION

Hamed (2016) defined population as number of persons living in a particular community. The population of this study were all grade 8 learners from Malamulele high schools.Table 1 shows the number of learnes in all the four schools, according to their gender. The total population was 709 learners.

Table 1: Study population

Name of scool	**No. Of boys**	**No. girls**	**Total**
Nhlaluko High School	132	78	210
PP Hlungwani High School	121	99	220
Mphambo High School	86	83	169
Mahlahle	50	60	110
Total	**389**	**320**	**709**

3.5 SAMPLING

A sample is a group of people or objects taken from a larger population for measurements (Cherry 2018). Sampling involved sampling of schools and respondents.

3.5.1 Sampling of schools

The schools were selected using purposive sampling based on the highest number of Grade 8 learners. The researcher selected three public high schools and one private high school. The four schools that were selected were: Nhlaluko High, PP Hlungwani High, Mphambo High and Mahlahle Private School.

3.5.2 Sampling of respondents

In participant sampling, a stratified random sampling technique was used, by dividing groups (strata) according to their schools and gender. Proportional sampling was then applied, in order to achieve the required sample, relative to their entire population.

3.5.3 Inclusion criteria

The inclusion criteria included the following:

- Grade 8 learners
- Male/female
- From the four mentioned school.

3.5.4 Sampling size

The sample size was determined using Slovin's formula (Borchani et al., 2015).

n= sample size of the adjusted population

N= population size which in this study was 709

e = acceptable level of error set at 0.05

$$n = N/1+N(e)^2$$

$$709/1+709(0.05)^2$$

$$709/1+709(0.0025)$$

$$709/1+1.7725$$

$$709/2.7725$$

$$255.72$$

$$N= 256$$

Therefore, sample size = 256

The sample size was increased to 300 to accommodate for non-responses.

Table 2 indicates how proportional sampling of respondents was calculated per school and per gender.

Table 2: Sampling frame

Name of school	No. boys	Percentage	No. respondents
Nhlaluko High	132	$\frac{132}{389} \times 55$ =19%	$\frac{165}{55}$ ×19% =57
PP Hlungwani High	121	$\frac{121}{389} \times 55$ =17%	$\frac{165}{55} \times 17\%$ =51
Mphambo High	86	$\frac{86}{389} \times 55$ =12%	$\frac{165}{55} \times 12\%$ =36
Mahlahle High	50	$\frac{50}{389}$ 55 =7%	$\frac{165}{55} \times 7\%$ =21
total	389	55%	165
Name of school	**No. girls**	**percentage**	**No. respondents**
Nhlaluko High	78	$\frac{78}{320} \times 45$ =11%	$\frac{135}{45} \times 11\%$ =33
PP Hlungwani High	99	$\frac{99}{320} \times 45$ =14%	$\frac{135}{45} \times 14\%$ =42
Mphambo High	83	$\frac{83}{320} \times 45$ =12%	$\frac{135}{45} \times 12$ =36
Mahlahle	60	$\frac{60}{320} \times 45$ =8%	$\frac{135}{45} \times 8\%$ =24
Total	**320**	**45%**	**135**

3.5.5 Sampling procedure

Respondents were selected using systematic random selection. To calculate the interval, the formula K=N/n (Charoo et al., 2017) was used. K= 709/300, = 2.3=2. Therefore, every 2nd learner on the register was selected for the study until the required number was reached. The names of boys on the attendance register were numbered on pieces of paper and put in a bowl and shaken. The researcher picked one name from the bowl without looking. The learner picked was the first boy to be included in the study. Thereafter, every 2nd boy was randomly selected from the list until the required number of boys was reached in that school. Again, the names of girls on the attendance register were numbered on pieces of paper and put in a bowl, shaken and the researcher picked one name without looking in the bowl. The learner randomly picked was the first to be included in the study and every second name on the list was selected, until the required number was reached. This procedure was repeated at the other three schools. The total sample size was 300.

3.6 DATA COLLECTION TOOLS

In order to collect data, two data collection tools were used; namely, a questionnaire and an assessment form.

3.6.1 Questionnaire

A self-administered questionnaire was used to collect data (appendix E). The questionnaire covered the factors affecting myopia. Section A comprised of Demographic factors, Section B: comprised of Family history, Section C: comprised of Socio-economic status and Section D: comprised of Environmental factors. Questions about the learners' daily activities and the time spent doing these activities were included in the questionnaire. The questionnaire was developed by the researcher, informed by previous literature and consisted of closed-ended questions. The questionnaire was in English.

3.6.2 Assessment form

The assessment form consisted of Variables for measuring Visual Acuity (VA), refraction and ophthalmoscope (appendix F).

3.7. RELIABILITY AND VALIDITY OF THE INSTRUMENT

In this chapter, the meaning of validity and reliability is discussed, as well as how the researcher ensured validity and reliability.

3.7.1 Validity

Validity is defined as the ability of an instrument to measure what it is supposed to measure (Noble and Smith, 2015). For the purpose of this study the researcher consulted the experts (supervisors) in the area for face validity; thus, the readability of the questionnaire was attested to verify the grammar or language used, so that it was attuned to the topic. To ensure content validity, the researcher consulted other optometrists, an opthalmologist as well as Ophthalmic nurses, to ensure that the questionnaire covered all the required aspects of myopia.

3.7.2 Reliability

According to Noble and Smith (2015) reliability is an extent to which results are consistent and are an accurate representation of a population over time.

To ensure that the instrument used for assessment was reliable, a test retest method was used. Only 10% of learners from grade 8 learners from the schools that were participating in the study but were not selected as respondents. This was because they had the same characteristics as the study population. The learners were examined twice on two consecutive Saturdays. For the questionnaire, to ensure stability of the instrument, the questionnaires were given to that 10% of learners to complete. The learners were given the same questionnaire to complete again on the following Saturday.

The Cronbanch alpha which measures the degree of internal consistency (0≤α≤1.0) of the instrument was used to ascertain the reliability of the instrument. The results yielded an alpha (α) value of 0.74, which enabled the researcher to conclude that the instrument had higher consistency and was thus reliable.

3.7.3 Calibration of the equipment

The equipment used were, ophthalmoscope, trial frame, trial lenses and snellen chat.A trial case consists of loose lenses and a frame. The frame was fitted on the learner's face and adjusted by the optometrist, depending on the size of the learner's face. A Snellen chart is a paper with alphabets on it, which was hung on the wall for the learners to read. The researcher used an ophthalmoscope which was not more than 5 years old and ensured that every 2 years the ophthalmoscope was sent to the manufacturer for servicing.

3.7.4 Assessment form

VA was measured at 6 meters at all times using a standardised Snellen chart. To ensure the reliability of visual acuity testing, the testing distance of 6 meters was maintained at all times. VA was measured on the right eye first, while covering the left eye. The same was done with the left eye, while covering the right eye.

3.8 PRE- TEST

A pre-test was conducted on 10% learners from grade 8 learners from a school which was participating in the study. These learners were not selected as study respondents. However, they had similar characteristics. The questionnaires were handed to the learners on a Saturday to complete at home. The learners were to return the completed questionnaires the following Saturday, where examinations were going to be conducted. The necessary corrections of the research instrument were done on the questions relating to the risk factors of myopia among children.

3.9 DATA COLLECTION PROCESS

Data was collected using a questionnaire and an assessment form.

3.9.1 Self-administered questionnaire

A self-administered questionnaire, consisting of closed ended questions, was handed to learners whose parents had given consent to complete at home. The questionnaires were completed by the learners, with the help of their parents/guardians. These questionnaires were distributed to learners by the researcher. After the learners have completed the questionnaires, the learners returned the completed questionnaires to the school on a Saturday. The researcher checked every completed questionnaire for any incomplete information and the response rate was high as only three questionnaires were not returned.

3.9.2 Assessment of children

The researcher performed the assessment of children. Children who completed the questionnaires and whose parents/guardians had given consent, were examined at their respective schools on a Saturday. An arrangement was made with the school management for permission to utilise the school premises. All examinations were conducted in the class room allocated by the school management. Each learner came to the examination room with their completed questionnaire. An assessment form was used to record the examination results. A standardised Snellen acuity chart was used to measure VA at a six-meter distance. Each eye was measured separately, starting with the right eye by covering the left eye. Then the same procedure was done for the left eye by covering the right eye. Learners' already wearing optical corrections had their visual acuity measured while wearing them. The results were then recorded on the assessment form and the researcher ensured that the assessment forms were clipped together with the completed questionnaire of the same learner. Refractive Error (RE) was measured using a trial frame and trial lenses at the same distance of 6 metres. Trial lenses are a set of loose lenses that are interchanged in front of the eye to determine the type of RE.

3.9.3 Eye examination

The researcher performed external and internal examination of the eye using a handheld ophthalmoscope in learners, whose vision did not improve with lenses, to rule out any pathological conditions. The results were recorded on the assessment form by the researcher. Learners with ocular conditions, myopia, hyperopia, and astigmatism requiring further management were referred to nearby optometrists.

3.10 DATA MANAGEMENT AND ANALYSIS

The researcher coded and captured the data. The researcher assigned codes for all data from the questionnaires using Microsoft Excel. The data was then converted to statistical data such as, mean and percentages, which were then presented in tables. The data was entered into the SPSS version 25.0.0.0 for analysis. Descriptive statistics was used, and the mean, standard deviation and frequencies were described using the Statistical Package for Social Sciences (SPSS version 25.00). The chi-square test was used to compare the demographic characteristics and myopia. The data was presented in tables and charts.

3.11 ETHICAL CONSIDERATIONS

This proposal was presented at the Department of Public Health and School of Health Sciences Higher Degree Committee for quality assessment. The proposal was also submitted to the University Higher Degree (UHDC) for quality assessment and approval. After obtaining approval from the UHDC, the proposal was submitted to the University of Venda Research Ethics Committee, to request for ethical clearance. After obtaining the ethical clearance, permission to conduct the study was obtained from the Provincial Department of Education (Appendix D). The approval from the Department of Education was submitted to the District office of education, to make arrangements to conduct the study from the respective schools.

3.11.1 Informed consent and assent form

The researcher disclosed all the information concerning the study by means of information letter (Appendix A) to the learners, for them to make an informed decision about the study. The information letter was also given to parents/guardians for them to make an informed decision of whether or not their children would participate in the study. This was communicated to all parents or guardians. The learners were also informed that they could pull ot at any time should they wish to do so without incurring any penalty. The assent forms were given to learners for signing. The consent forms were handed to learners, to give their parents/guardians for signing. Only learners with signed consent forms were included in the study.

3.11.2 Protection from harm

None of the methods or tests used was invasive in anyway. Lastly the aspects of the questionnaire did pose any psychological discomfort to the learners.

3.11.3 Right to privacy

To ensure privacy, learners were gathered in a waiting room and examinations were conducted in a separate room. All information obtained during the examination were safely filed in a place restricted only to the researcher and supervisors. The researcher did not share the information with anybody.

3.11.4 Anonymity and confidentiality

Each questionnaire was assigned a unique number that could not be linked to a learner in any way. Furthermore, the learners were not allowed to write their names on the questionnaires. Instead, codes were used. All information was accessible only to the researcher. The researcher also ensured that no information obtained during the study could be linked to a learner. Therefore, the signed assent forms and consent forms were placed separate from the questionnaires.

3.12 DISSEMINATION OF THE RESULTS.

A soft and hard copy of the dissertation will be submitted to the University of Venda library, Department of Health and the Department of Education. The results of the study will also be presented at conferences and published in accredited national and international journals.

3.13 SUMMARY

This chapter described the methods which the researcher applied to conduct this study. The chapter described the methods and techniques used in order to address the study objectives. Data was collected using the questionnaires and the assessment forms and the results are presented in the next chapter.

CHAPTER 4: PRESENTATION OF STUDY RESULTS

4.1 INTRODUCTION

The aim of this study was to investigate the prevalence of myopia and the risk factors associated with myopia among Grade 8 learners in Vhembe District. This part of the study presents the study findings and interpreting them based on the data collected. The presentation of study is done following the structure of the questionnaire/instrument used to collect data. The results are statistically presented in the form of frequencies and percentages. Originally, the study aimed at collecting data from 300 learners. However, the study revealed that only 297 participated, giving a 99% response rate.

4.2 DEMOGRAPHIC FACTORS

Figure 1 and 2 shows the distribution of the study respondents according to age. Out of n= 297 respondents, the majority 158 (53%) were females and 139 (46.6%) were males. Their age ranged from 13 to 16 years.

Figure 1 Distribution of respondents' age (n=297)

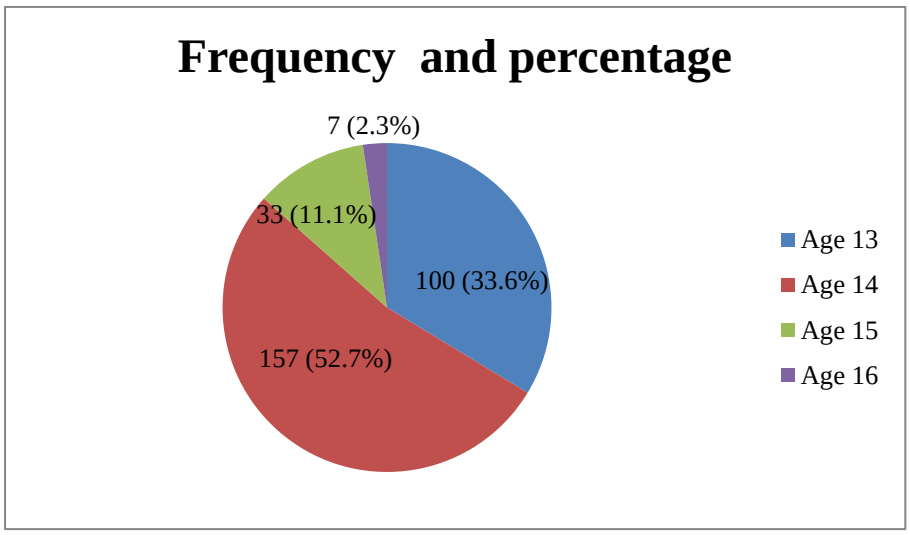
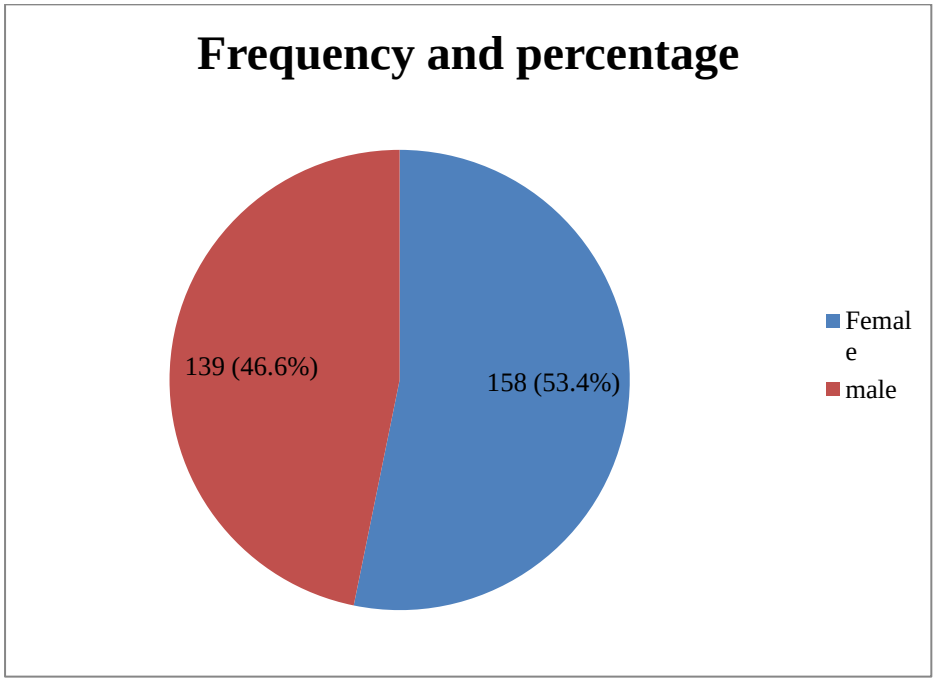


Figure 2 Distribution of respondents' gender (n=297)



Distribution of participant's by school

The number of children who participated in the study were 54 (18.1%) from Nhlaluko High school, 127 (42.6%) from PP Hlungwani High school, 72 (24.2%) from Mphambo High school and 44 (14.8%) from Mahlahle Combined school.

Parental information of respondents

The total number of learners who supplied the age of their fathers was 280, while 17 did not provide an answer. The age of the fathers ranging from 25-39 was 47 (15.7%), from 40-49 was 172 (57.7%), from 50-59 was (16.1%) while for 60 and above it was 13 (4.4%). Figure 3 also shows that 292 learners indicated the age range of their mothers, while 5 (1.7%) did not. A total of 141 (47.3%) had ages ranging from 25-39, 134 (45.0%) were aged 40-49, 17 (5.7%) were aged between 50-59 years. None (0%) of the learners had mothers who were 60 years and above.

4.3 FAMILY HISTORY

The respondents who had their eyes examined before were only 36 (12.1%), whilst the majority, 261 (87.6%) had never had an eye examination before. Furthermore, out of the 36 learners who had an eye examination before, 22 (7.4%) had spectacles prescribed. Frome those, 4 (1.3%) were prescribed spectacles because of their inability to see at a distance; 11 (3.7%) were prescribed spectacles because of their inability to see at a nearby/for computer use, while 6 (2.0%) did not know the reason why spectacles were prescribed for them. Out of the n=297 respondents, 79 (26.5%) indicated that there is someone in their family with poor eyesight, while 218 (73.4%) respondents indicated that none of their family members has poor eyesight. The number of learners who indicated that only their fathers have poor eyesight was 37 (12.4%), while the number of learners who had mothers with poor eyesight was 28 (9.4%). Meanwhile 14 (4.7%) learners indicated that other members of the family (besides their parents) had poor eyesight.

Distribution of family eyesight history

The majority 224 (75.4%) of learners indicated that none of their family members wear spectacles. The number of learners whose fathers wore spectacles was 32 (10.7%); learners whose mothers wore spectacles were 16 (5.7%), while 4 (1.3%) indicated that only their siblings wore spectacles. Those who indicated that both parents wore spectacles were 17 (5.7%) and those who indicated that both parents and siblings wore spectacles were 4 (1.3%). Table 4 also shows why these family members wear spectacles. Respondents who indicated that their fathers wear spectacles because of poor distance vision were 7 (2.3%); 21 (7.0%) for near vision, 20 (6.7%) for both distance and near, while 4 (1.3%) did not know why their fathers wear spectacles.

The number of respondents whose mothers wore spectacles for seeing at a distance were 4 (1.3%); 11 (3.7%) wore spectacles for near vision; 15 (5.0%) were for seeing at a distance and nearby, while 5 (1.7%) did not know why their mothers wore spectacles. For the respondents who indicated that their siblings also wear spectacles to see at a distance, for near vision and for both distance and near were, 3 (1.0%); 3 (1.0%); 3 (1.0%) respectively. Only 1 (0.3%) did not know why their siblings wore spectacles.

4.4 SOCIOECONOMIC STATUS OF RESPONDENTS' PARENTS

The number of respondents who indicated the educational level of their fathers was 296, while 3 (1.0%) did not answer the question. From the results, the respondents whose fathers had no educational background were 9 (3.0%); those with fathers whose highest educational level was primary school were 10 (3.4%); 141 (47.3%) had a secondary school qualification; 87 (29.2%) had tertiary education, while 48 (16.1%) did not know the level of education of their fathers. The results of the educational level of mothers are also shown. There were 2 (0.7%) respondents who did not indicate the level of education of the mothers. Of the 295 respondents who answered the question, 13 (4.4%) showed that their mothers had no formal education; 10 (3.4%) had gone up to primary school; 139 (36.6%) had gone up to secondary school, while 102 (34.2%) had a tertiary education. Those who did not know their mothers' level of education were 32 (3.7%).

4.5 EMPLOYMENT STATUS OF PARENTS

There were 13 (4.4%) of respondents who did not indicate the employment status of their fathers. Respondents whose fathers were employed were 193 (64.8%), while 92 (30.9%) were unemployed. There were 137 (46.0%) learners who indicated that their mothers were employed, while 159 (53.7%) respondents indicated that their mothers were unemployed.

4.6 ENVIRONMENTAL FACTORS

The results showed that the number of respondents who spent 30 minutes – 1 hour was 37 (12.4%); those who spent 1 – 2 hours were 57 (19.1%), whilst those who spent more than 2 hours were 198 (66.4%). There were respondents who stated that they do not spend any time indoors after school, and they were 5 (1.7%).

Table 3 Distribution of time spent indoors (n=297)

Time spent indoors		
Time	Frequency	Percentage
	1	.3
30 minutes-1 hour	37	12.4
1-2 hours	57	19.1
more than 2hours	198	66.4
None	5	1.7
Total	297	100.0

On reading and writing, the respondents who spent 30 minutes -1 hour were 100 (33.6%); those who spent 1 -2 hours were 141 (47.3%), more than 2 hours were 47 (15.8%) and those who said they spend no time reading and writing were 9 (3.0%).

respondents who spent 30 minutes – 1 hour using computer were 52 (17.4%); those who spent 1– 2 hours were 18 (6.0%), those who spent more than 2 hours were 18 (6.0%), while those who spent no time using computer were 209 (70.1%). The results also show that 115 (38.7%) of the respondents spent 30 minutes – 1 hour doing other indoor activities; 81 (27.1%) spent 1– 2 hours, while 29 (9.7%) spend more than 2 hours. Respondents who had no other indoor activities were 72 (24.2%).

Table 4 Distribution of the time spent reading and writing, using computer and other indoor activities (n=297)

Time spent reading and writing				Computer use		Other	
	Time	Frequency	%	Frequency	%	Frequency	%
		1	0.3	1	0.3	1	0.3
	30 minutes-1 hour	100	33.6	52	17.4	115	38.7
	1-2 hours	141	47.3	18	6.0	81	27.1
	more than 2hours	47	15.8	18	6.0	29	9.7
	None	9	3.0	209	70.1	72	24.2
	Total	297	100.0	297	100.0	297	100.0

From the results in Table 4, there were 43 (14.4%) respondents who indicated that they do not spend time outdoors at all. The respondents who spent 30 minutes – 1 hour were 93 (31.2%); those who spent 1-2 hours were 83 (27.9%), while those who spent more than 2 hours were 78 (26.2%). The respondents who spent 30 minutes – 1 hour playing sports were 29 (9.7%); those who spend 1 – 2 hours were 79 (26.5%), while those who spent more than 2 hours were 27 (9.1%). There were 161 (54.0%) respondents who said that they do not play sports.

Table 5 Distribution of time spent outdoors and playing sports (n=297)

Time spent outdoors			Time spent playing sports	
Time	Frequency	Percentage	Frequency	Percentage
	1	0.3	2	0.7
30minutes-1hour	93	31.2	29	9.7
1-2hours	83	27.9	79	26.5
more than 2hours	78	26.2	27	9.1
None	43	14.4	161	54.0
Total	**297**	**100.0**	**297**	**100.0**

There were 106 (35.6%) respondents who indicated that they do other outdoor activities after school, while 191 (63.8%) did not. From the respondents who responded that they do other activities outdoors, 61 (20.5%) spent 30 minutes -1 hour on these activities, 35 (11.7%) spent 1 – 2 hours and 12 (4.0%) spent more than 2 hours.

4.7 EYE EXAMINATION OF THE RESPONDENTS

The study also focused on examining the learners and the results are discussed in this chapter.

4.7.1 Unaided visual acuity

The VA was measured monocularly and the results are shown in Table 6. For the left eye, 266 (89.3%) learners had 6/6 VA; 7 (2.3%) had 6/7.5 VA; 10 (3,4%) had 6/9 VA; 4 (1.3%) had 6/10 VA; 5 (1.7%) had 6/12 VA; 3 (1.0%) had 6/18 VA; only 1 (0.3%) had 6/48 and 1(0.3%) had 6/60 VA.

Table 6 also shows results for the right eye. There were 269 (90.3%) respondents with 6/6 VA; 4 (1.3%) had 6/7.5 VA; 14 (4.7%) had 6/9 VA. Those who had 6/10 and 6/12 VA were equal, which were 3 (1.0%). There were 2 (0.7%) with 6/18 VA; 1 (0.3%) had 6/48 VA and 1 (0.3%) had 6/60 VA.

Table 6 Distribution of UVA (n=297)

Unaided VA of left eye			Unaided VA of right eye	
	Frequency	Percentage	Frequency	Percentage
6/6	266	89,3	269	90.3
6/48	1	0,3	1	0.3
6/60	1	0,3	1	0.3
6/7.5	7	2,3	4	1.3
6/9	10	3,4	14	4.7
6/10	4	1,3	3	1.0
6/12	5	1,7	3	1.0
6/18	3	1,0	2	0.7
Total	**297**	**100.0**	**297**	**100.0**

4.7.2 Diagnosis

Table 7 shows that 30 (10.1%) of the respondents had myopia, while 257 (86.2%) were emmetropic. The number of respondents who had hyperopia was equal to that of astigmatism, which were 5 (1.7%).

Table 7 Distribution of refractive error (n=297)

Diagnosis	Frequency	%
Myopia	30	10,1
Hyperopia	5	1,7
Astigmatism	5	1,7
Emmetropia	257	86,2
Total	**297**	**100.0**

4.8 ASSOCIATION BETWEEN DEMOGRAPHIC FACTORS AND REFRACTIVE ERROR

From Table 8 bellow, refractive error was compared with the participant's age, gender and the school they attend. The chi-squared p- value was found to be 0.000 which shows that there is an association between age and refractive error. Myopia was more prevalent among 13 year old respondents at 43.3% (13). Among the 14 and 15 year old respondents, the prevalence of myopia was 30% (9) and 26.7% (8). Myopia was not found among 16 year old respondents. When compared to gender, the chi-squared p-value was found to be 0.000, which indicates that there is an association between gender and refractive error. The prevalence of myopia was 30% (9) among females and 70% (21) among males. There was also an association between school and refractive error, with a chi- squared p- value of 0.000. Myopia was higher at Mahlahle Combined School than at the other schools, with a prevalence of 33.3% (10).

The prevalence of myopia was equal at Mphambo High School and Nhlaluko High School, with a prevalence of 30% (9) each. The lowest prevalence of myopia was found at P Hlungwani High School at, 6.7% (2).

Table 8 Association between refractive error and age, gender and school (n=297)

Age						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Age	13	13	2	2	83	100
	14	9	3	3	142	157
	15	8	0	0	25	33
	16	0	0	0	7	7
	Total	30	5	5	257	297
Gender						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Gender	female	9	4	2	143	158
	Male	21	1	3	114	139
	Total	30	5	5	257	297
School						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
School	Nhlaluko	9	3	2	40	54
	PP Hlungwani	2	0	0	125	127
	Mphambo	9	0	0	63	72
	Mahlahle	10	2	3	29	44
	Total	30	5	5	257	297

4.9 ASSOCIATION BETWEEN REFRACTIVE ERROR AND PARENTAL AGE AND LEVEL OF EDUCATION

When comparing parental age with refractive error, the chi- squared p- value was found to be 0.001 for fathers, and 0.000 for mothers, which shows that there is an association between parental age and refractive error. The prevalence of myopia was high among respondents whose fathers are aged 40-49, which was 40% (12). For the respondents whose fathers were aged 25-39, myopia prevalence was 10% (3); for those aged 50-59, myopia prevalence was 26.7% (8) and for those aged 60 and above, the prevalence was 13.3% (4). Myopia prevalence of 10% (3) was also present among respondents who did not indicate the age of their fathers.

The prevalence of myopia was found to be high in respondents whose mothers were aged 40-49, which was 60% (18).

Among the respondents whose mothers were aged 25-39, the prevalence of myopia was found to be 26.7% (8). A 10% (3) prevalence of myopia was found among respondents whose mothers were aged 50-59 years. There was no myopia found among respondents whose mothers were aged 60 and above.

The chi- squared p-value for the comparison between parental level of education and refractive error was found to be 0.000. This shows that there is an association between parental level of education and refractive error. Only 3.3% (1) prevalence of myopia was found among respondents whose fathers had no education. For the respondents whose fathers' level of education was primary school level, the prevalence of myopia was 3.3% (1), for those who went to secondary school, the prevalence of myopia was 30% (9) and for those who had tertiary education the prevalence of myopia was high, at 40% (12). The respondents who did not know their fathers' level of education had a myopia prevalence of 16.7% (5).

The prevalence of myopia was 6.7% (2) among respondents whose mothers had no education. Among the respondents whose mothers' had attained primary level education it was 3.3% (1); for those who had attained secondary level education it was 43.3% (13) and for those who attained tertiary education myopia prevalence it was 30% (9). Myopia prevalence of 16.7% (5) was also found among respondents who did not know the educational level of their mothers.

Table 9 Association between refractive error and parental age and (n=297)

Age of father						
P = 0.001		Refractive error				Total
		Myopia	Hyperopia	Astigmatism	Emmetropia	
Age of father		3	1	0	13	17
	25-39	3	1	1	42	47
	40-49	12	3	1	156	172
	50-59	8	0	3	37	48
	60 and above	4	0	0	9	13
	Total	30	5	5	257	297
Age of mother						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Age of mother		1	0	0	4	5
	25-39	8	4	1	128	141
	40-49	18	1	4	111	134
	50-59	3	0	0	14	17
	60 and above	0	0	0	0	0
	Total	30	5	5	257	297

Table 10 Association between refractive error and parents' level of education (n=297)

Highest level of education of father						
Count						
P = 0.000		Refractive error				
		myopia	hyperopia	astigmatism	Emmetropia	Total
Level of education		0	0	0	2	2
	none	1	0	0	8	9
	primary school	3	0	0	7	10
	secondary school	9	3	2	127	141
	tertiary education	12	1	3	71	87
	don't know	5	1	0	42	48
	Total	30	5	5	257	297
Highest level of education of mother						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Level of education		0	0	0	1	1
	None	2	0	0	11	13
	Primary school	1	0	0	9	10
	Secondary school	13	1	2	123	139
	Tertiary education	9	4	3	86	102
	don't know	5	0	0	27	32
	Total	30	5	5	257	297

4.10 ASSOCIATION BETWEEN REFRACTIVE ERROR AND EMPLOYMENT STATUS OF PARENTS

When the employment status of parents was compared to refractive error, the chi- squared p-value was found to be 0.000, which shows that there is an association between refractive error and employment status of parents. The prevalence of myopia was high among respondents whose fathers were currently employed, and it was 66.7% (20), while for those whose fathers were unemployed myopia prevalence was 26.7% (8). For those who did not indicate the employment status of their fathers, myopia prevalence of 6.7% (2) was found.

Myopia prevalence of 66.7% (20) was also found among respondents whose mothers were currently employed, while 33.3% (10) was found among respondents whose mothers were unemployed.

Table 11 Association between refractive error and employment status of parents (n=297)

Employment status of the father					
Refractive error					
P = 0.000		Myopia	Hyperopia	Astigmatism	Emmetropia
		2	1	0	9
	currently employed	20	4	4	165
	unemployed	8	0	1	83
Total		30	5	5	257
Employment status of the mother					
Refractive error					
P = 0.000	Myopia	Hyperopia	Astigmatism	Emmetropia	Total
	0	0	0	1	2
currently employed	20	2	3	112	137
unemployed	10	2	2	143	157
Total	30	5	5	257	297

4.11 ASSOCIATION BETWEEN REFRACTIVE ERROR AND RESPONDENTS' HISTORY OF EYE EXAMINATION

Table 12 indicates the results where refractive error was compared with the respondents' past eye examinations, if they had spectacles prescribed for them before and the reason why spectacles were prescribed. The chi- squared p- value was found to be 0.000 for all of them, which shows association. The prevalence of myopia was found to be 36.7% (11) among respondents who had had an eye examination before, and 63.3% (19) among those who had never had their eyes examined before. The prevalence of myopia among respondents who had had their eyes examine in the current year, a year before, previous 2 years and other was, 6.7% (2), 10% (3), 13.3% (4) and 6.7% (2) respectively. There was also a 63.3% (19) prevalence of myopia among respondents who did not indicate the year in which they had an eye examination.

Furthermore, there was an association between refractive error and whether spectacles were prescribed or not (Table 13). The prevalence of myopia was 23.3% (7) among respondents who had had spectacles prescribed for them before, while for those who had never had spectacles prescribed for them before, the prevalence of myopia was 76.7% (23). The chi- squared p- value of 0.017 was found when refractive error was compared with the reason why spectacles were prescribed. For inability to see at a distance, inability to see nearby and computer use, the prevalence of myopia was found to be 10% (3) and 6.7% (2) respectively. Among the respondents who did not know why spectacles were prescribed for them, the prevalence of myopia was 6.7% (2) and for those who did not answer the question, a myopia prevalence of 76.7% (23) was found.

Table 12 Association between refractive error and respondents' history of eye examination (n=297)

	History of eye examination				
P = 0.000	Refractive error				
	Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Yes	11	0	1	24	3
No	19	5	4	233	261
Total	30	5	5	257	297

Last eye exam of respondents						
Refractive error						
P = 0.000		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
when was the last exam		19	5	4	232	261
	current year	2	0	0	12	14
	year ago	3	0	0	9	12
	last 2 years	4	0	1	4	9
	other	2	0	0	0	2
	Total	30	5	5	257	297

Table 13 Association between refractive error and participant's history of spectacles (n=297)

History of spectacles prescribed						
Diagnosis						
P = 0.000		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
	yes	7	0	0	15	22
	no	23	5	5	242	275
Total		30	5	5	257	297
Reason for prescribed spectacles						
Diagnosis						
P = 0.017		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
		23	5	5	243	277
	inability to see distance	3	0	0	1	4
	inability to see near, for computer use	2	0	0	9	11
	don't know	2	0	0	4	6
Total		30	5	5	257	297

4.12 ASSOCIATION BETWEEN REFRACTIVE ERROR AND EYE FAMILY HISTORY

There was an association between refractive error and family history of poor eyesight. The chi- squared p- value was found to be 0.000 when respondents were asked if there is anyone in the family with poor eyesight.

The prevalence of myopia was 40% (20) among respondents who said that there was someone with poor eye sight at home, and 60% (18) among those who had no family members with poor eyesight. There was no association between refractive error and who has poor eyesight at home and the chi- squared p- value was 0.320. For those who said their father had poor eyesight, the prevalence of myopia was 13.3% (4). Among those who said that their mothers have poor eyesight, myopia prevalence was 23.3% (7), and among those who said other family members had poor eyesight, the prevalence was 3.3% (1).

Table 14 Association between refractive error and eye family history (n=297)

Family history of poor eyesight						
Refractive error						
P = 0.000		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
		0	0	0	0	1
	Yes	12	2	2	63	79
	No	18	3	3	194	218
Total		30	5	5	257	298
Family members with poor eyesight at home						
Refractive error						
P = 0.320		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
		18	3	3	194	219
219	father	4	1	0	32	37
	mother	7	1	1	19	28
	other	1	0	1	12	14
Total		30	5	5	257	297

4.13 ASSOCIATION BETWEEN REFRACTIVE ERROR AND TIME SPENT INDOORS

There was an association between refractive error and the time spent indoors, and the chi-squared p- value was found to be 0.000. Myopia prevalence was high among those who spent more than 2 hours indoors, at 63.3% (19).

The prevalence of myopia among respondents who spent 30 minutes – 1 hour, 1 – 2 hours and none, were 10% (3), 23% (7) and 3.3% (1), respectively.

When it comes to reading and writing, for the learners who spent 30 minutes- 1 hour, the prevalence of myopia was 33.3% (10); for those who spent 1- to 2 hours the prevalence was 56.7% (17). The prevalence of myopia among respondents who spent more than 2 hours reading and writing was 10% (3) and those who said they do not spend time reading and writing was zero.

When comparing the time spent using computer with refractive error, the chi- squared p-value was found to be 0.000. The prevalence of myopia among respondents who spend 30 minutes -1 hour was 16.7% (5), while for those who spent 1 – 2 hours the prevalence was zero. Among respondents who spent more than 2 hours using computer, the prevalence was 13.3% (4) and 70% (21) among those who did not use computer.

There were respondents who also spend time doing other activities indoors, and the chi-squared p- value was found to be 0.000. Among the respondents who spent 30 minutes – 1 hour doing other activities indoors, the prevalence of myopia was 40% (12), while for those who spent 1 – 2 hours, more than 2 hours and none, the prevalence was equal at 20% (6) for each.

Table 15 Association between refractive error and time spent indoors (n=297)

Time spent indoors						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time	30 minutes-1 hour	3	1	1	32	37
	1-2 hours	7	0	3	47	57
	more than 2hours	19	4	1	174	198
	None	1	0	0	4	5
	Total	30	5	5	257	297
Time spent reading and writing						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time	30minutes-1hour	10	0	3	87	100
	1-2hours	17	3	0	120	140
	more than 2hours	3	1	1	42	47
	None	0	1	0	8	9
	Total	30	5	5	257	297
Time spent using computer						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time	30minutes-1hour	5	1	2	44	52
	1-2hours	0	1	0	17	18
	more than 2hours	4	0	1	13	18
	None	21	3	2	183	209
	Total	30	5	5	257	1

4.14 ASSOCIATION BETWEEN REFRACTIVE ERROR AND TIME SPENT OUTDOORS

Time spent outdoors was compared with refractive error and the chi- squared p- value was found to be 0.000, which shows an association. The prevalence of myopia was high among the respondents who spend 30 minutes – 1 hour outdoors and lower with those who do not spend any of their time outdoors. Among those who spent 30 minutes – 1 hour, 1 – 2 hours, more than 2 hours and none, the myopia prevalence was 36.7% (11), 23.3% (7), 26.7% (8) and 1.3% (4), respectively.

There was also association between refractive error and time spent playing sports with a chi-squared p- value of 0.000. The prevalence of myopia among the respondents who spent 30 minutes – 1 hour playing sports was 6.7% (2), for those who spent 1- 2 hours the prevalence was 23.3% (7). The highest prevalence of myopia was found among respondents who do not play sports and it was 60% (18) while 10 % (3) was found among respondents who spent more than 2 hours playing sports.

There were respondents who indicated that they spend time doing other activities outdoors after school and the chi- squared p- value was found to be 0.000. The prevalence of myopia was 70% (21) among respondents who said they do not do any other outdoor activities after school, and 30% (9) was found among those who spent their time doing other outdoor activities. For those who spent 30 minutes – 1 hour doing other outdoor activities, the prevalence of myopia was found to be 13.3% (4). Among respondents who spent 1 – 2 hours and those who spend more than 2 hours, the prevalence of myopia was found to be 10% (4) and 6.7% (2), respectively.

Table 16 Association between refractive error and time spent outdoors (n=297)

Time spent outdoors						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time	30minutes-1hour	11	0	4	78	93
	1-2hours	7	2	1	73	83
	more than 2hours	8	1	0	69	78
	None	4	2	0	37	43
	Total	30	5	5	257	297
Time spent playing sports						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time		0	0	0	1	1
	30minutes-1hour	2	1	1	25	29
	1-2hours	7	2	2	68	79
	more than 2hours	3	0	0	24	27
	none	18	2	2	139	161
	Total	30	5	5	257	297

Table 17 Association between refractive error and other outdoor activities

Other outdoor activities						
P = 0.000		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
	yes	9	1	2	94	106
	no	21	4	3	163	191
	Total	30	5	5	257	297
Time spent doing other outdoor activities						
P = 0.957		Refractive error				
		Myopia	Hyperopia	Astigmatism	Emmetropia	Total
Time		21	4	3	161	181
	30minutes-1hour	4	1	2	54	61
	1-2hour	3	0	0	32	35
	more than 2hours	2	0	0	10	12
	Total	30	5	5	257	297

4.15. SUMMARY

This chapter was presenting the study results. The results indicated that myopia is common among high school children. Most of them had never had their eyes examined before. The results showed that myopia was more prevalent among the younger respondents (13) than the older age (16). Myopia was also high in private school than at the public schools. The next chapter discusses the results in comparison with other studies.

CHAPTER 5: DISCUSSION OF THE STUDY RESULTS

5.1. INTRODUCTION

In the current chapter, the results presented in Chapter 4 are interpreted and discussed in comparison with findings from other studies. As in the previous chapter, the discussion is organized into sections, according to the objectives of the study. The discussion focuses on the overall prevalence of myopia among high school learners. The demographic, environmental, socioeconomic risk factor variables associated with the prevalence of myopia are also discussed. This study investigated the prevalence and risk factors for myopia among schoolchildren in eight (8) Malamulele schools. Overall 297 grade 8 school learners between the ages of 13 to 16 participated in the study. As suggested by many studies, myopia is a very common cause of visual impairment throughout the world. Its prevalence varies by country, age and ethnic group (Saxen et al., 2015). It is therefore important for us to better understand this process and its risk factors, to better develop a prevention and treatment strategy, thus the relevance of this section.

5.2. PREVALENCE OF MYOPIA

The present study investigated the prevalence of myopia through the use of the assessment form. The findings revealed a smaller percentage of (10.1%) of myopia of the examined respondents. These findings are consistently similar to studies of myopia which were done in Ethiopia and Nigeria, in which 11.9% and 8% were the prevalence rates respectively (Atowa, Uchermad and Wajuihian, 2017. However, it is crucial to compare the prevalence rate of this study to the local studies, like the one by Baloyi, Akinsola, and Mabunda (2018), conducted in Malamulele, and it established a higher prevalence of myopia at 60%. This, therefore, brings in a bone of contention in which geographical locations can be a probable reason. However, this factor is discussed later in this section. Apart from geographical variations, this study assumes that age is crucial in the determination of the prevalence of myopia.

The study of Baloyi, Akinsola, and Mabunda (2018) had a higher prevalence rate than the present study, and this can be related to the age of respondents, as their study focused on primary school learners, while the present study focused on secondary school grade, 8 learners. Thus, it can be argued that myopia prevalence is usually higher among young primary kids than those in secondary school (Foster and Jiang, 2014). This sentiment was

confirmed by this study, as 13 years old respondents were reported to be the ones more affected than other age groups. This assumption of myopia which decreases with age is contrary to the population-based RE studies in South Africa, China India and Chile, which reported an increased rate of myopia with older age in children between the ages of 5 and 15 years. In particular, the study in China reported an apparent increase in myopia prevalence from 7 – 8-year-olds, which coincided with the age at which schooling begins (Theophanous et al., 2018).

The geographical location of the study area (Malamulele) of the present study, which is a semi-urban township, might have contributed to the lower 10.1% of myopia prevalence. In support of this, Saxen et al. (2015) attested that while there are no large-scale studies in India for assessing the magnitude of myopia in the school-going population, available studies show higher prevalence rates in urban areas, compared to rural areas. In addition,the schools in which the present study was conducted, where both public and private schools. However, it was established that there was a higher prevalence of myopia in private school (Mahlahle Combine School) than in public schools (Mphambo, Nhlaluko, and PP Hlungwani). The present study correlates with the work of Saxena et al. (2015), wherein it was found that the myopia was significantly higher in university students than in students at high school or lower. In this case, education might be the main reason behind the increase, as the literature suggests that the increase in the prevalence rate of myopia, concomitant with higher levels of schooling, might have resulted from greater demands for near work, and was not necessarily because of age (Mohammed-Aleman, 2018).

The present study also found that myopia was more common among male respondents than females. In contrast, the COMET study results on visual acuity differ considerably as they found that there was no difference between males and females. However, the National Health and Nutrition Examination Survey showed that women had a higher prevalence than men for myopia among the 20-40-year-old population, but that this was not consistent among other age groups (Hou et al., 2018). Furthermore, the reason for the above was given by the COMET study's multivariate analysis, which found that males have a slower progression rate of myopia than females, which supports the previous conflict of an increased female prevalence of myopia at age 20-39. However, In contrast to the COMET study, a study on childhood myopia (with subjects between 6 years and 15 years) by Jin et al. (2017) supported the present study, as it also found that gender did not have much effect on the prevalence of childhood myopia.

5.3. EYE HISTORY OF THE CHILD AND FAMILY HISTORY

The present study established that family history is a risk factor for myopia, wherein the prevalent rate was high in all the respondents who had one or both parents having myopia. Paudel et al. (2014) concurred that studies have shown that parental myopia, even in one parent, leads to an increased risk for juvenile myopia and that there is greater than a six-fold increased risk of juvenile-onset myopia if both parents are myopic. A study in Australia also emphasized this assertion, as it presents the rate of possibilities of developing myopia, considering family history; for example, incident myopia in six-year-old children, which increased from 7.8% with no parental myopia to 21.4% and 22.0% with one or both parents having myopia, (Mc Cullough, O'Donoghue and Saunders, 2016). This same study found that European Caucasian children with parental myopia had increased incidence of myopia.

In this regard, one can argue that parental myopia is not only a risk factor for having myopia, but is also a risk factor for progressive myopia in children. However, few authors like Wu et al., (2015) did not find any strong evidence that supports the hypothesis that heredity is a strong factor because parents with myopia have children who do more near work. Wlliams et al. (2019) came to the same conclusion as the present study, as they also observed that higher myopic prevalence in adulthood was strongly associated with parents' myopia, but that neither near work nor outdoor activities were significantly associated with early myopia. A more detailed epidemiological explanation was presented by Parssine and Kauppinen (2016), who attested that a recent genome-wide association study on the development of myopia found that numerous genetic factors are involved in the development of myopia, and suggested that the eventual development of myopia may result from early eye and neuronal development.

5.4. SOCIO-ECONOMIC STATUS OF PARENTS

The results of this study revealed that parents who are educated from (secondary level to tertiary level) had many children with myopia whereas patents with no education had few myopic patients. Similarly, studies in China and Korea revealed that higher family income was associated with higher risk of myopia (Parssinen and Kauppinen, 2016), and this tendency likely relates to lifestyle differences, such as amount of near work, reading, outdoor time, or computer time, but no differences in exercise, as this was controlled for in our analysis. Furthermore, the prevalence of myopia in the present study was found to be higher among employed parents than in unemployed counterparts.

A similar study supported the present findings, as it suggested that data on ocular dimensions (for example, axial length) may be useful for further understanding of the anatomical mechanisms of myopia associated with higher education, near work occupation, and higher socioeconomic status (Tham et al., 2018). An example was given by Raman et al. (2019), who stated that the onset and progression of myopia among medical students and clinical macroscopic are related to changes in axial lengths and vitreous chamber depths, suggesting possible associations between higher education and near work occupation with axial myopia. However, it should also be noted that whether these associations are alike in the general adult population are uncertain. In a previous study among adult Chinese living in Singapore, it was also reported that people with higher education, near-work occupations (for example managers, professionals, and office workers) and higher incomes, as well as those who lived in good housing, were more likely to have a myopic refraction (Hou et al., 2018)

Contrary to the present study, Mohammed-Aleman (2018) attested that patients who lived in a neighbourhood whose median family income was between $25,000 and 49,000 had a lower rate of myopia, compared to those in neighbourhoods whose median family income was less than $25,000. However, a limitation of this argument is that patients' family incomes were not known and, instead, the median income of their neighbourhood was used. Although this reflects their surrounding socioeconomic environment, it lacks the granular detail of their circumstances. The present study, therefore, views that it is anticipated that both individuals, as well as community-level socioeconomics, play a role in determining myopia risk, and further study is necessary to discern the relative influence of each factor.

5.5. ENVIRONMENTAL FACTORS

The respondents who spent much of their time partaking indoor activities were reported to develop myopia by the present study, where the ones who spent much time outdoors were free from myopia, and the indoor activities were reading, writing and watching TV. These findings correlates with the work of Recknol and Stahl (2015), who attested that several studies have been conducted to examine different environmental or non-genetic factors that may factor in the development of myopia and these, include the amount of near- work, such as reading or hand-held electronics, a child’s activities during the day.

Theophanous et al. (2018) further supported the present notion, that although genetic factors play a role in the development of myopia, the rapid growth in prevalence is likely attributable to environmental and lifestyle factors.

Prior studies have demonstrated an association between myopia and near-work activities, such as studying, reading, and screen time among children. Animal experiments suggest that near work may result in hyperopic defocus of the retina leading to excessive growth of the eye, with resultant myopia. Additionally, the time spent outdoors is protective against myopia, potentially due to light stimulation of retinal dopamine which discourages axial growth. Furthermore, the CLEERE Study Group consistently showed in their longitudinal study that near work activities in children who became myopic differed from emmetropic children before myopia, claiming that near-work can be a causative factor for myopia. This then attests that one of the most popular and an impactful association is outdoor time. In health promotion many studies have found that outdoor time has a negative, or protective, association with myopia, (Paudel et al., 2014) performed a meta-analysis to summarize the published reports on the association of outdoor time and myopia in children under 20 years. Their results not only confirmed that increasing time spent outdoors reduces the risk of developing myopia, but the pooled information indicated a 2% reduced odds of myopia for each additional hour spent outdoors per week. Therefore, this offers a practical intervention for myopia prevention with the many other health benefits associated with outdoor activities.

5.6 CONCLUSIONS

This study investigated the prevalence and risk factors associated with myopia among schoolchildren in eight (8) Malamulele schools. The following conclusions were drawn from the study;

- Demographic factors, such as gender and geographical locations are associated with the development of myopia, wherein it was more common among males respondents than females.
- Respondents who spent much of their time partaking indoor activities, such as reading and watching TV, are at risk of developing myopia.
- Parents who are educated (from secondary level to tertiary level) have more children with myopia than those patents with no education.
- Family history is a risk factor for myopia, as all the respondents who had one or both parents having myopia were found to have myopia too.

5.7 RECOMMENDATIONS

The present study acknowledges that myopia is a growing problem and the recommendations cover, practice, policy and the need for further research. Current data indicate that both the rate and severity of myopia may be increasing over time. The present study therefore recommends that more eye health education must be conducted by the Department of Health to the community of Malamulele. Given the profound impact myopia has on an individual and population basis, urgent interventions are needed to help mitigate the prevalence and severity of this condition.

Recommendations to practice: The discussion in the previous chapter demonstrated that exercise may be a modifiable risk factor that could represent a future target for public health interventions, to curb the progression of myopia. Given that these findings, which are consistent with prior studies that have identified a protective effect of time outdoors and sports participation, exercise can be a cornerstone of healthy lifestyle practices and is already being encouraged through multiple widespread public health campaigns and health talks in children and the community. The health benefits of exercise are numerous, and lowering the risk of myopia may be another benefit of exercise that ophthalmologists can discuss with their patients and the parents. More activities that reduce myopia should therefore be implemented at schools.

Recommendations to policy: Considering the findings and the discussion made, the Departments of Health and Education must develop policies that will strengthen the eye screening of children at schools. To prevent intemperate use and abuse of supposed myopia treatment methods, clinical practice guidelines can also be issued to establish clear indications and limitations of contact lens and laser refractive surgery in the management of myopia.

Recommendation to research: Given a noticeable limitation that the data in this study was obtained in schools from only one town and few schools participated in the study, further research with a larger sample is recommended. The goal of myopia research in the community will lie in developing practical approaches that will ultimately alter the biological course of the condition, ideally to prevent the start of myopia altogether. In line with this, basic science research will be directed towards identifying genetic markers of myopia, understanding cellular pathways of emmetropisation and developing animal models for clinical trials.

These recommended clinical research will be centred on irregular trials to prevent or slow myopia progression (topical eye drops, rigid contact lenses), and to correct myopia (refractive surgery trials).

5.8 SUMMARY

In summary, this chapter discussed the findings of this study in relation to other studies and previous published work in different settings. Points of agreement and disagreement were reached. However, the debate has given a better understanding and this shows that the study is significant. However generalization is not possible.

6 REFERENCES

Aldebasi, Y.H. 2014.Prevalence of correctable visual impairment in primary school children in Qassim Province, Saudi Arabia.*Journal of Optometry.* (7),168-176.

Alrasheed, S.H, Naidoo, K.S. And Clarke-Farr, P,.C. 2016. Prevalence Of Visual Impairment And Refractive Error In School-Aged Children In South Darfur State Of Sudan. *African Vision And Eye Health.75, (1).*

Atchison D.A and Rose´n R., 2016.The Possible Role of Peripheral Refraction in Development of Myopia.*Optometry and Vision Science.93,(9).*

Atowa, U.C., Munsamy, A.J., and Wajuihian, S.O., 2017. Prevalence and risk factors for myopia among schoolchildren in Aba, Nigeria. African Vision and Eye Health, 76(1), 1-5.

Baloyi, V.H.A., Akinsola, H.A. and Mabunda, J.T., 2018. Pattern of distribution of refractive error among primary school children in the Malamulele community of Limpopo province, South Africa. African Journal for Physical Activity and Health Sciences (AJPHES), 24(Supplement 1),142-152.

Belete, G.T., Anbesse, D.H., Tsegaye, A.T. and Hussen, M.S., 2017. Prevalence and associated factors of myopia among high school students in Gondar town, northwest Ethiopia, 2016. *Clinical optometry*, *9*,11.

Borchani, H., Varando, G., Bielza, C. and Larranaga, P., 2015. A survey on multi-output regression.Wiley Interdisciplinary Reviews; Data mining and knowledge Discovery.5, (5) 216-233.

Boyd, M.A, 2013. Psychiatric nursing: contemporary practice.5th edition. Content Technologies and Cram 101 textbook reviews

Charoo, N.A., Durivage, M., Rahman, Z zndAyad, M.H., 2017.Sample size for Tablet compression and capsule filling events during process validation.*Journal of pharmaceutical sciences, 106, (12),3533-3538*

Chen, M., Wu, A., Zhang, L., Wang, W., Chen, X., Yu, X. and Wang, K., 2018. The increasing prevalence of myopia and high myopia among high school students in Fenghua city, eastern China: a 15-year population-based survey. *BMC ophthalmology,* 18(1), 159.

Cherry, K., 2018. Sample types and errors in research.*www.verywellmind.com/2795877*. Updated October 12, 2018

Congdon, N., Burnett, A. and Frick, K., 2019. The impact of uncorrected myopia on individuals and society. Community eye health, 32(105), 7.

Czepita, M., Czepita, D. and Lubiński, W., 2017. The influence of environmental factors on the prevalence of myopia in Poland. *Journal of ophthalmology*, 2017.

Darko-Takyi, C., Owusu-Ansah, A., Appiah-Eduenu, C., Abu, E.K., Boadi-Kusi, S.B. and Osei-Akoto, Y., 2016. Refractive and binocular vision status of optometry students, Ghana. *Journal of Medical and Biomedical Sciences,* 5(2), 24-29.

De Houwer, J, Barnes-Holmes, D and Moors, A., 2013. What is learning? On the nature and merits of a functional definition of learning. *Psychonomic society*. 3.

Ding, B.Y., Shih, Y.F., Lin, L.L., Hsiao, C.K. and Wang, I.J., 2017. Myopia among schoolchildren in East Asia and Singapore. Survey of ophthalmology, 62(5), 677-697.

Dolgin, E., 2015. The myopia boom.*Nature, 519(7543),* p. 276.

Dong, Y.H., Liu, H.B., Wang, Z.H., Xu, R.B., Yang, Z.P., Ma, J., 2017. The epidemic status and secular trends of myopia prevalence for Chinese children and adolescents aged 7-18 years from 2005 to 2014. Ahonghuayu fang yixuezazhi [chines journal of preventive medicine.*51(4)* 285-9.

Foster, P.J and Jiang, Y 2014. Epidemiology of myopia.*Eye*. Cambridge ophthalmology symphosium. *28 (2)*,202–208.

Galvis, V., Tello, A., Otero, J., Serrano, A.A., Gómez, L.M., Camacho, P.A. and López-Jaramillo, J.P., 2018. Prevalence of refractive errors in Colombia: MIOPUR study. *British Journal of Ophthalmology*, 102(10),1320-1323.

Government gazette 37254, January 2014. Childresn's Act 38 of 2005. 18.

Grzybowski, A., Kanclerz, P., Tsubota, K., Lanca, C. and Saw, S.M., 2020. A review on the epidemiology of myopia in school children worldwide. *BMC Ophthalmology*, 20(1),1-11.

Guggenheim, J.A, McMahon, G, Northstone, K, Mandel, Y, Kaiserman, I, Stone, R.A, et al. 2013.Birth Order and Myopia.Ophthalmic Epidemiology.Informa Healthcare USA,

Hamed, T., 2016. Sampling Methods in Research Methodology, How to choose a sampling technique for research. *Internationa Journal of Academic Research in Management*, 5 (2), 18-

27

Hamm, L.M., Black, J., Dai, S. and Thompson, B., 2014. Global processing in amblyopia: a review. *Frontiers in psychology*, *5*, 583.

Hashemi, H., Yekta, A., Jafarzadehpur, E., Ostadimoghaddam, H., Etemad, K., Asharlous, A., Nabovati, P. and Khabazkhoob, M., 2016. High prevalence of refractive errors in 7 year old children in Iran. *Iranian journal of public health*, 45(2),194.

Holden, B.A, Fricke, T.R., Wilson, D.A., Jong, M., Naidoo K.S., Sankaridurg, P., Wong, T.Y., Naduvilath, T.J., and Rensikoff, S, 2016.Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050.*American academy of ophthalmology.123(5).*

Hou, W., Norton, T.T., Hyman, L., Gwiazda, J. and COMET Group, 2018. Axial elongation in myopic children and its association with myopia progression in the Correction of Myopia Evaluation Trial (COMET). Eye & contact lens, 44(4), 248.

Hung, G,.K, Mahadas, K and Mohammad, F.2016. Eye growth and myopia development: Unifying theory and Matlab model. Computers in Biology and Medicine.*20.*P. 106-118

Ji, Y., Rao, J., Rong, X., Lou, S., Zheng, Z. and Lu, Y., 2017. Metabolic characterization of human aqueous humor about high myopia. Experimental eye research, 159, 147-155.

Jonas, J.B., Xu, L., Wang, Y.X., Bi, H.S., Wu, J.F., Jiang, W.J., Nangia, V., Sinha, A., Zhu, D., Tao, Y. and Guo, Y., 2016. Education-related parameters in high myopia: adults versus school children. PloS one, 11(5).

Kedir, K and Girma, A., 2014. Prevalence of Refractive Error and Visual Impairment Among Rural School-age Children of Goro District, Gurage Zone, Ethiopia. *Ethiopian Journal of Health Sciences,* 24 (4).

Lam, C.S-Y., Lam, C-H., Cheng, S.C-K.and Chan,, L.Y-L., 2012. Prevalence of myopia among Hong Kong Chinese schoolchildren: changes over two decades. *Ophthalmic & Physiological Optics*.*32 (1*),17-21

Mohammed Alemam, A., Aldebasi, M.H., Rehmatullah, A., Alsaidi, R. and Tashkandi, I., 2018. Prevalence of Myopia among Children Attending Pediatrics Ophthalmology Clinic at Ohud Hospital, Medina, Saudi Arabia. Journal of ophthalmology, 2018.

Mountjoy, E., Davies, N.M., Plotnikov, D., Smith, G.D., Rodriguez, S., Williams, C.E., Guggenheim, J.A. and Atan, D., 2018. Education and myopia: assessing the direction of causality by mendelian randomisation. bmj, 361,2022.

Naidoo, K.S., Leasher, J., Bourne, R.R., Flaxman, S.R., Jonas, J.B., Keeffe, J., Limburg, H., Pesudovs, K., Price, H., White, R.A. and Wong, T.Y., 2016. Global vision impairment and

Naito, T., Yoshikawa, K., Mizoue, S., Nanno, M., Kimura, T., Suzumura, H., Umeda, Y. and Shiraga, F., 2016. Relationship between visual field progression and baseline refraction in primary open-angle glaucoma. *Clinical ophthalmology (Auckland, NZ),* 10,1397.

Noble, H. and Smith, J., 2015. Issues of validity and reliability in qualitative research.*Evidence-based Nursing, pp.ebnurs.*

O'donoghue, L, Kapetanankis, V.V, Mcclelland, J.F, Logan, N.S, Owen C.G, Saunders, K.J And Rudnicka, A.R., 2015. Risk Factors For Childhood Myopia: Findings From The Nicer Study. *Investigative Ophthalmology & Visual Science.56, 1524-1530*

Ohno-Matsui, K., 2016. Pathologic myopia. *The Asia-Pacific Journal of Ophthalmology*. *5*(6), 415-423.

Pan, C.W., Ramamurthy, D. and Saw, S.M., 2012. Worldwide prevalence and risk factors for myopia.*Ophthalmic& Physiological Optics*,32, 6-9.

Park, H.Y.L., Hong, K.E. and Park, C.K., 2016. Impact of age and myopia on the rate of visual field progression in glaucoma patients. Medicine, 95(21).

Pärssinen, O. and Kauppinen, M., 2016. What is the influence of parents' myopia on their children's myopia progression? A 22-year follow-up study. Acta ophthalmologica, 94(6), 579-585.

Paudel, P., Ramson, P., Naduvilath, T., Wilson, D., Phuong, H.T., Ho, S.M. and Giap, N.V., 2014. Prevalence of vision impairment and refractive error in school children in B a R ia–V ung T au province, Vietnam. Clinical & experimental ophthalmology, 42(3),217-226.

Peltzer, K., Phaswana-Mafuya, N., Arokiasamy, P., Biritwum, R., Yawson, A., Minicuci, N., Williams, J.S., Kowal, P. and Chatterji, S., 2015. Prevalence, circumstances and consequences of non-fatal road traffic injuries among older people in china, Ghana, India, Mexico, Russia and South Africa. African Safety Promotion: A journal of injury and violence prevention. 13(2), 59-77.

Rathod, H.K., Raghav, P.R. and Mittal, S., 2011. Profile of School Going Children with Visual Impairment.*Indian Medical Gazette*,434.

Recknol, M. and Stahl, E.D., 2015. Childhood myopia: epidemiology, risk factors, and prevention. Missouri medicine, 112(2), 116.

Robinson, O.C., 2014. Sampling in interview-based qualitative research: A theoretical and practical guide. Qualitative Research in Psychology.11 (1), 25-41

Rudnicka A, R., Kapetanakis V.V., Wthern A. K., Logan N.S., Gilmartin B., Whincup P.H., Cook D.G and Owen C.G., 2016. Global variations and time trends in the prevalence of childhood myopia, a systematic review and qualitative meta-analysis: implications for aetiology and early prevantion. *British Journal of Ophthalmology*. 882-890

Salih, A.A. 2018. Prevalence and Progression of Refractive Errors Among El-Mustansiriyah Medical Students. *Eurasian Journal of Medicine and Oncology. 2 (2), 79-83.*

Santomingo-Rubido, J., 2017.Theories behind myopia progression.Menicon co. Ltd. DOI: 10.13140/RG.2.2.18893.03040

Saxena, R., Vashist, P., Tandon, R., Pandey, R.M., Bhardawaj, A., Menon, V. and Mani, K., 2015. Prevalence of myopia and its risk factors in urban school children in Delhi: the North India Myopia Study (NIM Study). *PloS one*, *10*(2), e0117349.

Sewunet S.A., Aredo K.K. and Gedefew M, 2014.Uncorrected refractive error and associated factors among primary school children in DebreMarkos District, Northwest Ethiopia.*BMC ophthalmology. 14(95).*

Schaeffel, F. and Feldkaemper, M., 2015. Animal models in myopia research. *Clinical and Experimental Optometry*, 98(6),507-517.

Sherwin,J.C. and Mackey, D.A., 2013. Update on the Epidemiology and Genetics of Myopic Refractive Error. *Expert Review of Ophthalmology*. 8(1), 70-72.

Sithole, H,.L. 2013. A critical analysis of the South African health policies and programmes with regard to eye health promotion. Submitted in accordance with the requirements for the degree of *Doctor Of Literature And Philosophy.*University Of South Africa.

Szklo, M. and Nieto, F.J., 2014. *Epidemiology: beyond the basics*. Jones & Bartlett Publishers.

Taqi, A.A and Saeed DH., 2016.Functional Outcome and Patient Satisfaction after LASIK for Correction of Myopia: A Clinical Study. *International Journal of Medical Research Professionals*. 2(4), 27-30.

Tham, Y.C., Lim, S.H., Shi, Y., Chee, M.L., Zheng, Y.F., Chua, J., Saw, S.M., Foster, P., Aung, T., Wong, T.Y. and Cheng, C.Y., 2018. Trends of visual impairment and blindness in the Singapore Chinese population over a decade. Scientific reports, 8(1), pp.1-7.

Theophanous, C., Modjtahedi, B.S., Batech, M., Marlin, D.S., Luong, T.Q. and Fong, D.S., 2018. Myopia prevalence and risk factors in children. Clinical ophthalmology (Auckland, NZ), 12, p.1581.

Vision Impact Institute-WhitePaper, 2012, the social and economic impact of poor vision.
Wajuihian S.O and Hansraj R et al 2017 Refractive error in a sample of black high school children in South Africa. *Optometry and vision Science*, *94 (12), 1145-1152*

WHO 2004.final draft. Chapter 4.Determinants (Risk and Protective Factors) Indicators.Cited on the 21st February 1015.

Williams, K., Hysi, P.G., Sasaki, S., Tideman, W., Yazar, S., Wedenoja, J., He, M., Parssinen, O., Mackey, D.A., Klaver, C.C. and Hammond, C.J., 2019. Effect of the age of myopia onset, environmental factors and genetic risk on myopia in the CREAM Consortium. Investigative ophthalmology & visual science, 60(9).

Williams, K.M., Verhoeven, V.J., Cumberland, P., Bertelsen, G., Wolfram, C., Buitendijk, G.H., Hofman, A., Van Duijn, C.M., Vingerling, J.R., Kuijpers, R.W. and Höhn, R., 2015. Prevalence of refractive error in Europe: the European eye epidemiology (E 3) consortium. *European journal of epidemiology*. *30*(4), 305-315.

Wong, Y.L. and Saw, S.M., 2016. Epidemiology of pathologic myopia in Asia and worldwide. *The Asia-Pacific Journal of Ophthalmology,* 5(6), 394-402.

Wu, L.J., You, Q.S., Duan, J.L., Luo, Y.X., Liu, L.J., Li, X., et al. 2015. Prevalence and Associated Factors of Myopia in High-School Students in Beijing. 10(3), e0120764

Wu, P.C., Huang, H.M., Yu, H.J., Fang, P.C. and Chen, C.T., 2016. Epidemiology of myopia.*The Asia-Pacific journal of ophthalmology. 5(6), 386-393.*

www.dhsd.limpopo.gov.za.

Appendix A: Consent form

I Mathebula Daphney hereby, invite you to participate in this study. Please note that any information you will provide will be handled in uttermost confidentiality and therefore will not be revealed to anybody without your consent. Please note that your participation is voluntary, meaning to say you are free to pull out at any time should you feel uncomfortable or threatened during the progression of the study.

Signature of researcher…… Date……

I ……..have read and understood the contents and terms of this invitation to participate in this study. I hereby proclaim that I am voluntarily participating in this research.

Respondent signature…….. Date……

For more information contact Mathebula D (Researcher)-0837341740 or daphneymathebula@webmail.co.za

APPENDIX B: ASSENT FORM

You are being asked to take part in a study conducted by Mathebula D at University of Venda. In this study you will be requested to complete a questionnaire about your daily activities. You will also have your eyes tested.

This will take 10-15 minutes to do so. All the information collected will be kept secret and you don't have to share your answers in the questionnaire anybody else. We will not use your name so everything will remain private.

By signing this you are showing that you have asked questions about this research and understand what is going to happen. You can also ask questions later should you have them. Signing this form does not mean that you have to finish the study, you can pull out from the study at any time without giving reasons.

…… ……

Learner's signature Date

APPENDIX C: LETTER OF INFORMATION

Name: Mathebula D

Supervisors: Dr N.S Mashau and Mrs SE Tshivhase

Dear research participant, thank you for showing interest in this study: Prevalence and risk factors of myopia among Grade 8 learners in Vhembe District

I, Mathebula D, a Master of Public Health student at the University of Venda, invite you and your child to take part in a study conducted by me. In this letter, all information regarding the study will be explained in order for you to make a decision whether to participate or not. Should you decide to participate, you will be provided with a consent form to sign as an indication that you have agreed to participate in the study. The purpose of this study is to determine the prevalence of myopia and the risk factors associated with myopia amongst high school children.

About 300 children will be randomly selected from the class lists. selected children will be given questionnaires to complete and then then undergo an eye examination. The examination will take place in the classroom at their respective schools. Children found to have ocular conditions and refractive errors requiring further management will be referred to nearby institutions. Only 10-15 minutes will be required for each participant. Children with any ocular diseases and systemic diseases will be excluded.

There are no risks involved in this study. All procedures/tests are non-invasive. However, all children who will be found to have visual problems will be referred to relevant institutions for further management after having been notified.

Participation in this study is voluntary and you can refuse to participate if you wish to do so. You can at any time during the study decide to withdraw your participation without having to incur any punishment.

There will be no monetary or any other form of remuneration given to respondents. All costs of the study will be covered by the researcher and not the respondents.

All information provided by you and/or your child will be kept confidential. No personal information that can be linked to you shall be written on the report of this study. In case of research related injuries, the involved person will be rushed to nearby institution and will be compensated for.

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher (0837341740), my supervisor (015 962 8892) or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za

Kind regards

Mathebula D

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

Ref: 2/2/2 Enq: Mabogo MG Tel No: 015 290 9385 E-mail:MabogoMG@edu.limpopo.gov.za

Mathebula D
P O Box 5068
Giyani
0826

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.
2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"PREVALENCE AND RISK FACTORS OF MYOPIA AMONG GRADE 8 LEARNER IN VHEMBE DISTRICT , SOUTH AFRICA "**
3. The following conditions should be considered:

3.1 The research should not have any financial implications for Limpopo Department of Education.

3.2 Arrangements should be made with the Circuit Office and the School concerned.

3.3 The conduct of research should not in anyhow disrupt the academic programs at the schools.

3.4 The research should not be conducted during the time of Examinations especially the fourth term.

3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).

3.6 Upon completion of research study, the researcher shall share the final product of the research with the Department.

CONFIDENTIAL

Cnr. 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X9489, POLOKWANE, 0700
Tel: 015 290 7600, Fax: 015 297 6920/4220/4494

The heartland of southern Africa - development is about people!

APPENDIX E: QUESTIONNAIRE

Instructions

- Carefully read all questions and answer to the best of your ability by ticking the appropriate box (☑) and/or filling in the spaces provided.
- to be completed by the child
- If you need any assistance please feel free to ask.

SECTION A: DEMOGRAPHIC FACTORS

Information of the child

1. Age: _____
2. Gender: □ Female □ Male
3. School: _____

Personal information of parents

4. Questionnaire completed by: □ Biological father
   □ Biological mother
   □ Legal guardian
   □ Other (please specify):_____

5. Age:

Father	Mother
□ 25-39	□ 25-39
□ 40-49	□ 40-49
□50-59	□50-59
□60 and above	□60 and above

SECTION B: FAMILY HISTORY

Eye history of the child

6. Haveyouever had an eye exam? □ Yes □ No

If yes, when was the last exam? □ in the current year

□ a year ago

□ in last 2 years

Other (specify)_____

7. Have spectacles been prescribed for you before? □ yes □ no

If yes, what was the reason for spectacles? □inability to see at distance

□inability to see at near, for computer use

□don't know

At what age did you start wearing spectacles? _____

8.Is there anyone in your family with poor eyesight? □ yes □ no

If yes, who? □ father

□ mother

□ other (specify)_____

Does anyone in your family wear spactacles?	What was the reason for wearing spectacles?		
	Father	Mother	Sibling
□ father □ mother □ sibling □ none	□ for seeing at a distance □ for seeing at near, computer or any	□ for seeing at a distance □ for seeing at near, computer or any near work □ all of the	□ for seeing at a distance □ for seeing at near, computer or any near work □ all of the

	near work □ all of the above □ don't know	above □ don't know	above □ don't know

Section C: Socioeconomic status of parents

9. Highest level of education

Father	Mother
□ None	□ None
□ Primary school	□ Primary School
□ Secondary School	□ Secondary School
□ Tertiary education	□ Tertiary education
□ Don't know	□ Don't know

10. Employment status

Father	Mother
□ currently employed	□ currently employed
□ Unemployed	□ Unemployed

SECTION D: Environmental factors

11. How much time do you spend indoors after school (excluding time spent sleeping)_____ □ 30 minutes- 1 hour

□ 1 hour - 2 hour

□ more than 2 hours

□ none

12. How much time do you spend indoors after school doing the following:

Reading and writing	computer use	Other (specify)_____
□ 30 minutes- 1 hour □ 1 hour - 2 hour □ more than 2 hours □ none	□ 30 minutes- 1 hour □ 1 hour - 2 hour □ more than 2 hours □ none	□ 30 minutes- 1 hour □ 1 hour - 2 hour □ more than 2 hours □ none

13. How much time do you spend outdoors after school:

□ 30 minutes- 1 hour

□ 1 hour - 2 hour

□ more than 2 hours

□ none

14. How much time do you spend outdoors playing sports after school?

□ 30 minutes- 1 hour

□ 1 hour - 2 hour

□ 1 hour - 2 hour

□ more than 2 hours

□ none

15. Are there any other outdoor activities you do after school on a daily basis? □ yes □ no

How much time do you spend doing such activitities? □ 30 minutes- 1 hour

□ 1 hour - 2 hour

□ more than 2 hours

APPENDIX F: ASSESSMENT FORM

Section A: visual acuity (unaided visual acuity and pinhole visual acuity)

Unaided visual acuity (UVA)		Pinhole visual acuity(PVA)	
Right eye (RE)		Right eye	
Left eye(LE)		Left eye	

Section B: subjective refraction

	Spherical power
Right eye	
Left eye	

Section c: ophthalmoscopy

External exam

Right eye		left eye
	Eyelids	
	Conjunctiva	
	Cornea	
	Iris	

Internal examination

Right eye		left eye
	Anterior chamber	
	Lens	
	Fundus	
	CD ratio	
	Macular	

Other

Section D: diagnosis

- [ ] Myopia
- [ ] Hyperopia
- [ ] Astigmatism
- [ ] Emmetrope

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:

Ms D Mathebula

Student No:
11565239

PROJECT TITLE: **Prevalence and risk factors of Myopia among grade 8 learners in Vhembe District, South Africa.**

PROJECT NO: **SHS/19/PH/21/0110**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr NS Mashau	University of Venda	Supervisor
Ms SE Tshivhase	University of Venda	Co- Supervisor
Ms D Mathebula	University of Venda	Investigator – Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: October 2019
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Senior Prof. G.E. Ekosse

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2019 -10- 04
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950 LIMPOPO PROVINCE, SOUTH AFRICA
TELEPHONE (015) 962 8000/8315 FAX (015) 962 9000
"A quality driven financially sustainable, rural-based Comprehensive University"