UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE SUB-DISTRICT IN NORTH-WEST PROVINCE, SOUTH AFRICA.

MASTER OF PUBLIC HEALTH

NP NDOU

2014
UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE SUB-DISTRICT IN NORTH-WEST PROVINCE, SOUTH AFRICA.

by

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH

in the

FACULTY OF HEALTH SCIENCES

of the

UNIVERSITY OF LIMPOPO, SOUTH AFRICA

2014

PROMOTER: PROF. NTAMBWE GUSTUV MALANGU
DECLARATION

I, Nndiliseni Priscila Ndou, hereby declare that “UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE SUB-DISTRICT IN NORTH-WEST PROVINCE, SOUTH AFRICA”; a short dissertation for Masters of Public Health at the University of Limpopo-MEDUNSA campus, is my own work and has not been submitted for any degree either at this university or any other institution of learning, and that all sources and references in this study have been duly acknowledged.

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SIGNATURE…………………………
DATE: MAY 5, 2014
ACKNOWLEDGEMENTS

I would like to extend my sincere gratitude and appreciation to all individuals who made this study possible;

- To Almighty God, Jehovah Jireh for guiding and sustaining me through it all.
- To the participants, headmasters and all the staff members of Dikeledi Makapan, Mphebatho, Rantebeng, Swarisanang and Tlholoe primary schools, for allowing me to somehow disrupt their classes, and for being so patient when I became a “constant feature” in their respective learning institutions.
- I will be forever grateful to my former employer, Mr Keevan Sher of Value Vision Optometrists, for allowing me to utilize his resources for phase two data collection, and for going an extra mile by providing children in need of refractive correction with a pair of spectacles.
- I also owe a debt of gratitude to Professor M.G. Malangu for his research expertise, the constructive criticism, the professional guidance, as well as his patience. How I wish confidence was easily contagious . . .
- Last but not least, to my daughter Tshedza, who although had limited knowledge on this project (of studying MPH), sacrificed more than she should.
SUMMARY

Purpose: The study was conducted to investigate uncorrected refractive error prevalence and distribution; to determine if refractive errors have any associated with age and gender; as well as to investigate barriers for not utilizing refractive error corrective devices among the primary school children of Moretele sub-district of North-West province of South Africa.

Methods: Grade 3 to 7 children were sampled from primary schools within geographically defined clusters in Moretele sub-district. Vision screening were conducted in schools using a Tumbling-E visual acuity chart to identify children with poor visual performance. Visual acuity measurement, non-cycloplegic retinoscopy, subjective refraction, self-reported visual function, external and fundus examinations were conducted.

Results: A sample comprised of 476 eligible grade 3 to 7 primary school children, aged 8 to 15 years, mean age 10.9±1.7 standard deviation; 56% were female. The study found an overall refractive error prevalence of 7.1%. A significant finding is that an alarming proportion(97%) of these refractive errors was not corrected. The most common refractive error was myopic astigmatism (1.9%), followed by myopia (1.5%), hyperopia (1.4%), hyperopic astigmatism (1.2%) and simple astigmatism (0.9%). No statistic significance was found between socio-demographic variables and refractive error status. Lack of awareness was noted among 63.6% as the barrier to correcting refractive errors.

Conclusion: The study found an overall refractive error prevalence of 7.1%. The most common refractive error was myopic astigmatism, followed by myopia, hyperopia, hyperopic astigmatism and then simple astigmatism. A significant finding is that most of the refractive errors were uncorrected because these children were not receiving eye care services as part of the school health program as it is done in other areas in South Africa. This should be strengthened.

Key words: uncorrected refractive errors, school children, vision screening, lack of awareness.
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CHAPTER ONE: BACKGROUND OF THE STUDY

1.1 Introduction

Refractive error is an ocular and visual disorder characterized by the inability of an eye to focus a clear image on the retina, resulting in a blurred and/or distorted vision; which if severe and remain uncorrected, usually leads to impaired vision (World Health Organization, 2006). Globally, 2.3 billion people are estimated to have poor vision due to refractive error (Naidoo & Jaggernath, 2012). Uncorrected, refractive error is increasingly being recognized worldwide as a significant cause of avoidable visual disability; hence a public health problem among different population groups (Ovenseri-Ogbomo & Omuemu, 2010).

Estimated to be accountable of 43% visual impairment, uncorrected refractive error has recently been declared the principal cause of avoidable visual disability among school children (Pascolini & Mariotti, 2012). Among school children these errors have considerable impact on learning and academic achievement especially in underserved and under-resourced communities (World Health Organization, 2006). Globally, refractive errors are the main cause of vision impairment in 5 to 15 aged children, of which without appropriate optical correction, millions of children are losing educational opportunities (Holden, 2007). World Health Organization is said to have estimated that 13 million 5 to 15 year olds children are visually impaired due to uncorrected refractive error worldwide (Sharma et al, 2012).

Low vision is frequently the reason for poor academic performance among school children; and due to early age onset in children - the duration of the refractive error effect is also significant as it can account for twice as many blind-person-years compared to the cataract (Krishnaiah et al, 2009). Christian Blind Mission emphasizes that in economic terms, for children to live with visual impairment entails the life of time loss of a person’s working capacity; therefore, restoring sight to children is been found to be an effective instrument to reduce poverty stemming from visual impairment. The correction of refractive error to
eliminate this form of visual disability has been included as a priority component within the planned areas of action campaign under Vision2020: The Right to Sight; Global initiative for the elimination of Avoidable Blindness (World Health Organization, 2001).

Ocular refractive error is remediable with spectacles, contact lenses or laser surgery. Since spectacles are more cost effective and appropriate refractive error correction for children; they remain the most frequently and widely used corrective devices (World Health Organization, 2006). Economically, the cost of establishing and operating the educational and refractive care facilities required to deal with vision impairment resulting from uncorrected refractive errors was found to be a small proportion of the global loss in productivity associated with the corresponding vision impairment (Fricke et al, 2012).

1.2 Problem statement

However, despite the launching of VISION 2020 campaign over a decade ago, and the 2007 Durban declaration on refractive error and service development (International Centre for Eye care Education, 2007), there is dearth of refractive error data in South Africa. Nationally, very few studies have been reported on refractive errors. There are no reported refractive error studies on primary school children of Moretele district, in the North-West province.

It also have been observed that children referred by the Gauteng School Health Service nurses to a local private optometric practice (researcher’s work place) for vision assessment; have poor vision and only a few had prior visual examination. Unfortunately similar services are not available for their peers in Moretele area, the neighboring North-West Province. And these school children are required to sit for the same exam papers, irrespective of the fact that there are obvious national as well as provisional disparities in school and visual health service provision.
1.3 Study rationale
For planning and to enable updated global estimates in 2015 and 2020, Holden (2007) recommends that visual impairment due to uncorrected errors studies be conducted in enough key locations; and World Health Organization (2006) emphasizes that data are crucial in improving the delivery and output of current ocular refractive error services. It is also emphasized that school vision screening programme can identify and treat or refer children with refractive error (Sharma et al, 2012)

1.4 Research purpose
To investigate the prevalence of uncorrected refractive errors, distribution of the types of uncorrected refractive errors and barriers for not utilizing corrective devices among primary school children who would be detected with uncorrected refractive errors in Moretele sub-district, North-West Province of South Africa.

1.5 Research questions
1. What is the prevalence of uncorrected refractive errors among primary school children of Moretele sub-district in North-West province, South Africa?
2. What is the distribution of uncorrected refractive errors among the primary school children of Moretele sub-district in North-West province, South Africa?
3. Is there any association between uncorrected refractive errors and demographic variables (sex and age) among the primary school children of Moretele sub-district in North-West province, South Africa?
4. What is the proportion of children who have visual/ocular complaints among the primary school children who have uncorrected refractive errors in Moretele sub-district, North-West province of South Africa?
5. What are the possible barriers for not utilizing refractive error corrective devices among primary school children who have uncorrected refractive errors in Moretele sub-district, North-West province of South Africa?
1.6 Research objectives

1. To investigate the prevalence of uncorrected refractive error among primary school children of Moretele sub-district in North-West province, South Africa.

2. To determine the distribution of uncorrected refractive errors among the primary school children of Moretele sub-district in North-West province, South Africa.

3. To determine the association between uncorrected refractive errors and demographic variables (sex and age) among the primary school children of Moretele sub-district in North-West province, South Africa.

4. To assess proportion of children who have visual/ocular complaints among the primary school children who have uncorrected refractive errors in Moretele sub-district, North-West province of South Africa.

5. To determine possible barriers for not utilizing refractive error corrective devices among primary school children who have uncorrected refractive errors in Moretele sub-district, North-West province of South Africa.
CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

In this section an overview of the refractive errors, the refractive error measure and of the visual impairment will be given. The purpose of this review is to synthesize the findings by prior researchers on the prevalence and distribution of refractive errors, the correlation of participants’ demographic variables to refractive errors, the possible barriers to correcting refractive errors and then the concluding remarks will be given.

2.1.1. Refractive errors

Emmetropia refers to an eye with no refractive error, whereas ametropia is a general term applied to an eye with any refractive error.

Refractive error/ametropia is a disorder that occurs when parallel rays of light entering a non-accommodating eye are not sharply focused on the retina. Primarily, ocular refractive errors refer to myopia, hyperopia, astigmatism and presbyopia. Myopia, referred to as shortsightedness. A myopic eye struggles to see distance objects clearly. Hyperopia often referred to as farsightedness. A hyperopic eye tends to accommodate/focus in excess in order to keep the images of near or close range objects clearer. Individuals affected with hyperopia might be prone to eyestrain and headaches. Astigmatism causes distorted blurry vision due to the irregularity of the ocular refractive media.

Presbyopia – a gradual loss of an eye’s ability to focus and read fine prints at near, this happens as the intraocular lens gradually loses its accommodative properties. Thus this type of refractive error is associated with the advanced age and mostly manifest around the age of 40 years, hence it will not be the focus of this study.

People with refractive errors might be affected by one or a combination of these conditions. It might be a simple myopia, hyperopia, astigmatism, compound and/or mixed refractive errors. For instance, an eye may have both myopia and astigmatism, and this combination is called myopic-astigmatism, and an individual may have myopic-astigmatism and/or
hyperop-astigmatism simultaneously instead of having a simple myopia, hyperopia or astigmatism. An individual may be affected by unequal and/or two differing refractive errors, thus we talk of anisometropia.

2.1.2. Refractive error measure

An important measure of visual function is the distance visual acuity (VA), and is based on an assessment of the ability to discern letters, numbers or figures on an eye chart at specified distances (O'Connor & Keeffe, 2007). Visual acuity of 6/6 is regarded as normal eyesight – and it literally mean that a person with normal vision can see at 6 meters a letter on an eye chart that is designed to be seen at 6 meters. Visual acuity may also be presented in inches. For instance, with visual acuity of 20/40 an individual is only able to discern at 20 inches a letter on an eye chart that is designed to be seen at 40 inches. And a visual acuity of 6/6 is considered an equivalent with that of 20/20.

2.1.3. Visual impairment due to refractive errors

These refractive errors are accountable for a globally estimation of 153 million people who are visual impaired - presenting with visual acuity of less than 6/18 in the better eye (WHO, 2006). Of those, 12.8 million are said to be 5 to 15 old children (Ovenseri-Ogbomo & Omuemu, 2010).

Many people with poor vision have refractive error that can be corrected or improved with optical means; however low vision is a form of vision impairment that involves irreversible vision loss (O'Connor & Keeffe, 2007). Uncorrected, refractive error may lead to amblyopia and/or strabismus (Murthy, 2000). Ovenseri-Ogbomo & Omuemu, 2010) explains that blindness is defined in terms of VA less than 6/30 in the better eye, and low vision as visual acuity from 6/18 to 6/30 in the better eye.

Without refractive error correction, distance vision impairment (presenting with visual acuity of less than 6/18) may limit visual function/performance (Smith et al., 2009). In South Africa, with visual acuity of 6/18 or less in the better eye, one cannot get a driver’s license.
With the level of significant visual impairment being the visual acuity of less than 6/18 in the adult population, WHO (2001) recommends that for children, binocular vision with visual acuity of less than 6/12 be considered significant.

2.1.4. Correction of refractive errors

Ocular refractive error is correctable with spectacles, contact lenses or laser surgery. Since spectacles are the more cost effective and more appropriate refractive error correction for children; they remain the most frequently and widely used refractive error corrective devices (WHO, 2006). Al Rowaily & Alanizi (2010) emphasizes that the use of refractive error corrective devices can prevent vision loss.

2.2. Prevalence and distribution of refractive errors

Literature on refractive errors, uncorrected refractive errors as well as the distribution of such refractive errors were consulted and reviewed in order to gain more insight on the subjects.

To determine the prevalence of uncorrected refractive errors and their associated risks factors among 12 to 16 year olds Singapore children, Ho et al., (2005) conducted a cross-sectional study among 628 school children and those whose habitual visual acuity was 0.2 Log MAR or worse underwent subjective refraction. This grade seven children Singapore study produced 22.3% of poor vision, refractive error contributing to 95%, which was noted to be more common among pupils with low academic ability (Ho et al., 2005).

In Gombak District, a Malaysian suburban area, Goh et al (2005) conducted a household survey on refractive error prevalence and visual impairment among four thousand six hundred thirty-four multi-ethnic (70.3% Malay, 16.5% Chinese, 8.9% Indian, and 4.3% other ethnicity) 7-15 year olds school children. Conducting the visual acuity assessments, auto-refraction under cycloplegia and retinoscopy, the “Refractive error and visual impairment in school-age children in Gombak District, Malaysian study” was well armed to identify children with refractive errors and visual impairment as well as to differentiate
such refractive errors. 17.1% of the respondents were found with uncorrected refractive errors, 10.1% of children had refractive correction and 1.4% of the respondents had best-corrected visual acuities of 20/40 or less, thus they were visually impaired. Goh et al (2005) noted that in eyes with reduced vision, refractive error was the cause in 87.0%; and also realized that more than half of those in need of spectacles were without them.

In Yongchuan, Western China, a door to door survey was conducted to investigate the distribution and prevalence of refractive errors, of which 3070 children comprising of 6 to 15 year olds were examined; and Pi et al (2010) reported myopia, astigmatism and hyperopia prevalence as 13.75%, 3.75% and 3.26% respectively. Pi et al (2010) make mention of the Visual Acuity(VA) testing distance as four meter, however the VA cut-off detail is omitted, yet the refractive error is defined in terms of spherical equivalence.

However, in metropolitan southern China, a door-to-door survey conducted among 5 to 15 years of age children was to assess refractive error prevalence and visual impairment; and of 4364 respondents examined 22.3%, 10.3% and 0.62% had uncorrected, presenting and best-corrected visual acuity of 20/40 or worse in the better eye respectively (He et al, 2004). Of 2335 eyes with reduced vision, refractive error was the cause in 94.9% and amblyopia in 1.9%. Whereas in rural southern China, vision of 13 to 17 years of age 2400 schoolchildren were assessed during a prospective cross-sectional survey; and prevalence of uncorrected, presenting and best-corrected visual acuities of 20/40 or worse in the better eye were 27.0%, 16.6% and 0.46% respectively; with refractive error being the cause of reduced vision in 97.1% eyes and amblyopia in 0.81% (He et al, 2007). In Guangzhou, southern China 60% of those school children with poor vision and who could achieve acuity of 20/32 or better in at least one eye were found without the necessary refractive error correction, thus in need of spectacles (He et al., 2007).

There seem to be extensive refractive error and visual impairment data among the Chinese school children; however due to the inconsistency in methodologies and differences in age groups the findings are not comparable. For instances, although the two Chinese studies with He as the lead researcher reported myopia as the most prevalent of the refractive errors, the approaches to the studies differ. Yet, uncorrected refractive errors, myopia in
particular remain a dynamic and significant cause of avoidable visual impairment among these Chinese children.

In an earlier study conducted in New Delhi, India, Murthy et al (2002), assessed refractive error and related visual impairment in a total of 6447 (aged 5 to 15 years) urban population children and reported the prevalence of uncorrected, presenting and best-corrected visual acuities as 6.4%, 4.9% and 0.8% respectively; with hyperopia and myopia prevalence noted as being 7.7% and 7.4% respectively and also realizing that 81.7% of those with vision loss had refractive errors while 4.4% were amblyopic.

An Indian comparative study on magnitude and determinants (age, sex, family history of refractive error and use of spectacles) of uncorrected refractive error among 6 to 15 years of age - 5021 urban and 7401 in rural Maharashtra school children, Padhye et al. (2009) utilized visual acuity of 6/12 or worse as the defective vision; and the prevalence of uncorrected refractive error was reported as 5.46% and 2.63% for urban and rural participants respectively. Uncorrected refractive error was the reason of defective vision in 77% urban and 90% rural participants. And the respective distributions of myopia, hyperopia and astigmatism as 3.16%, 1.06% and 0.16% for urban and 1.45%, 0.39% and 0.21% rural children (Padhye et al., 2009), indicating myopia as the more prevalence refractive error and that it is more common among the urban group. Padhye et al. (2009) also noted amblyopia prevalence as were 0.8% and 0.2% for urban and rural areas respectively. Yet in a recent Indian cross-sectional study conducted among 2570 6 to 14 primary school urban school children in low-income families of Kolkata, ocular examination including refraction was done to study patterns of visual impairment and refractive error (Ghosh et al, 2012). According to Ghosh et al (2012) poor visual acuities were due to refractive error in 356 while 18 respondents were amblyopic; and the respective prevalence of myopia and hyperopia were 11.9% and 2.5%. It was also noted that visual acuities of worse than 6/12 in the better eye was present in 4.2% and 0.2% children pre- and post-correction respectively. Ghosh et al (2012) also noted that while refractive error prevalence was noted as 14.7%, only 0.16% respondents had refractive correction.
2002 Saudi primary school children aged 6 to 14 years were recruited for a cross-sectional study to assess refractive error prevalence, and of those who failed visual acuity test and underwent comprehensive visual examination, 13.7% had poor vision due to refractive errors (Al Wadaani et al, 2013). While only 9.4% of participants with poor vision wore spectacles, Al Wadaani et al (2013) reported that 12 to 14 year olds were more affected and myopia was more prevalent. Al Wadaani et al (2013) also noted female gender and older age as the risk factors.

Still in Saudi Arabia, King-Abdul Aziz Medical City, Al Rowaily (2010) conducted a gender stratified refractive error study of which the population consisted of 1319 kindergarten and primary school entry children who attend obligatory health examination. With the visual acuity cut-off of 20/28, the habitual acuity of 577 boys and 742 girls, aged 4 to 8 years were determined, and 60 respondents were noted for failing the visual acuity test due to refractive error. With the overall refractive error prevalence of 4.5%; 4.2% in boys and 4.9% in girls; the respective myopia, hyperopia and astigmatism prevalence were 2.5%, 2.1% and 2.5%; whereas amblyopia and strabismus prevalence were 0.5% each (Al Rowaily, 2010).

Conducting another Saudi Arabian refractive error study, Al Rowaily teamed with Alanizi in determining the prevalence of uncorrected refractive errors among 1536 Saudi children who were 12 to 13 years of age; Al Rowaily & Alanizi (2010) subjected the respondents to a visual acuity assessment and auto-refraction performed by a qualified optometrist. However unlike in the previous study in which Al Rowaily utilized visual acuity measures of 20/28, as a team the respondents with visual acuity measures of 20/30 or 6/9 or worse were referred for comprehensive visual assessments. 209 children were diagnosed with one or more refractive errors which yielded an overall prevalence of 9.8%, and the respective astigmatism, myopia, and hyperopia prevalence were 6.5%, 4.5% and 1.5% (Al Rowaily & Alanizi, 2010). The study also noted that only 15.3% children with refractive errors used spectacles. However if taking into consideration the Saudi Arabian study methods, particularly among the 4 to 8 age group and the findings by O'Donoghue et al (2012) who investigated the utility of uncorrected visual acuity measures in screening for refractive error in children. O'Donoghue et al (2012) argued that among school children,
the use of visual acuity charts can reliably detect myopia, but not hyperopia or astigmatism. On a study among the 4 to 8 year olds children, Al Rowaily failed to take into consideration that this age group is notorious for high amount of accommodation, thus passing a visual acuity assessment of 20/28 does not exempt them from refractive error, particularly hyperopia.

Also basing their findings solely on a mere visual acuity measurements (with VA cut-off of 6/9); Opubiri and Pedro-Egbe (2013) reported a refractive error of only 2.2% among the 5-15 years of age 1242 school children in Bayelsa state of Nigeria. This is regardless the fact that some children suffering from hyperopia may still see a 6/6 and better during visual acuity assessments. O'Donoghue et al (2012) argues that among school children, the use of visual acuity charts can reliably detect myopia, but not hyperopia or astigmatism. Of which Fotouhi et al (2011) also emphasized that since screening results of 20/20 visual acuity for school children does not necessarily indicate normal eye status as hyperopia and astigmatism may still be sources for visual discomfort; therefore to identify such cases and increase the sensitivity of the screening tests, measurement of refractive errors by cycloplegic refraction tests might be included in vision screening programmes. In their study attempting to prove the importance of including refractive tests other than merely visual acuities in determining refractive error prevalence, Fotouhi et al (2011) reported that of 3481 respondents 524 failed visual acuity measurements (with the respective myopia and hyperopia prevalence of 16.9% and 22.4%); yet 80.5%(2957) of the school children had 20/20 vision or better. However 16.1% of the 2957 participants who passed the visual acuity test had refractive error, with 10.1% being hyperopic, 6.6% astigmatic and 0.4% myopic. Seemingly Fotouhi et al (2011) ‘s findings concur with those of O'Donoghue et al (2012), who reported that among school children, the sole use of visual acuity charts can reliably detect myopia, but not hyperopia or astigmatism.

Thus the low refractive error prevalence found in Bayelsa state of Nigeria may due to the fact that many hyperopic eyes could have been missed. Another critical issue on the study reported by Opubiri and Pedro-Egbe (2013); is that the exclusion criteria is also based on age; it is stated that 11 of 1253 school children screened, were excluded as they were older
than 15 years of age. It could be argued that their academic progress might have been slowed due to poor visual performance hence they were still in primary schools.

To determine the prevalence of refractive errors among school children in urban and rural areas of Dezful County in Iran, Fotouhi et al. (2007) assessed unaided and best corrected visual acuities among 5544 (3673 elementary and middle school, and 1871 high school) children, ages ranging from 7 to 18 years. Of 224 respondents who failed the visual acuity of 20/40 and underwent refraction, 3.4% of primary school children were myopic and 16.6% hyperopic, on the other hand 2.1% of high school children were myopic and while 33.0% were hyperopic (Fotouhi et al., 2007). Of the 3.8% considerable poor vision reported, Fotouhi et al. (2007) asserts that uncorrected ocular refractive error was responsible for 95%. In this Iranian study, hyperopia seems to be the dominant refractive error. Fotouhi et al. (2007) also added that refractive error correlate with age, and that there was a high rate of unmet need for the refractive error correction.

A population-based cross-sectional analytic survey conducted among 2340 Thai (1100 in Bangkok and 1240 Nakhonpathon) children ranging in age from 6 to 12 years, utilized visual acuity and pinhole assessments to identify those with reduced vision; and poor vision was reported in 12.7% and 5.7% respondents in Bangkok and Nakhonpathon respectively, with 97.6% uncorrected refractive error prevalence (Yingyong, 2010). For the two groups, Yingyong (2010) reported myopia, hyperopia and astigmatism prevalence in Bangkok and Nakhonpathon as 11.1%, 1.4% and 0.3%; and 4.3%, 1.3% and 0.2% respectively. This Thailand’s Refractive Error Study in Children (RESC) also noted 0.5% amblyopia prevalence.

Salomâno et al. (2008) recruited 11 to 14 year olds low income Brazilian school children in São Paulo, and 2441 were examined to assess prevalence and causes of vision impairment. Those with visual acuity of 20/40 or worse in either eye underwent comprehensive visual examination and it is reported that the respective prevalence of uncorrected, presenting and best corrected visual acuity of 20/40 or worse in the better eye were 4.82%, 2.67% and 0.41%. While refractive error was responsible for 76.8% of those with poor vision among the Brazilian children, 11.4% were amblyopic.
While the prevalence of presenting visual impairment in the better eye was 3.6% in 12-13 year olds compared with 1.5% in 6-7 year olds children in Northern Ireland, O’ Donoghue et al (2010) noticed that almost 1 in 4 children fails to bring their spectacles, hence strategies to improve spectacle wear compliance among children are indicated.

In Ethiopia, of 4238 school children (aged 7 to 18 years) screened for refractive errors, 9.6% were visually impaired with visual acuities of 6/12 or worse (Mehari & Yimer, 2013). According to Mehari & Yimer, (2013) respondents who were visually impaired underwent further ocular examination and both objective and subjective refractions. 65.9% (267) had refractive errors with the overall prevalence of 6.3%. 138 respondents had visual acuity of 6/12 or worse due to corneal defects, amblyopia and strabismus, and the respective 12.8%, 9.6% and 1.1% (Mehari & Yimer, 2013). It should be borne in mind that uncorrected, refractive error may lead to both amblyopia and strabismus.

In a school-based cross-sectional study carried-out to estimate the prevalence and distribution of refractive error among school children in the Cape Cost Municipality in the central region of Ghana, Ovenseri-Ogbomo & Omuemu (2010) reported that 961 were examined; with the VA cut-off of 6/12 visual acuities were assessed, and both objective and subjective refractions were conducted in accordance to the RESC protocol; and refractive error prevalence 25.6% is reported; astigmatism, myopic and hyperopic distribution were noted as 14.1%, 6.9% and 4.6% respectively. While only 0.6% had history of visual assessment, uncorrected refractive error was the most common cause of visual impairment, and the prevalence of low vision and blindness was 0.9% and 0.1% respectively (Ovenseri-Ogbomo & Omuemu, 2010). Yet in another similar (with the exception that the respondents were subjected to non-cycloplegic refraction study) conducted in Agona Swedru; and of which Ovenseri-Ogbomo teamed with Assien, 15.5% of 595 (11 to 18 years school children) who failed the VA 6/12 test were subjected to a non-cycloplegic refraction (Ovenseri-Ogbomo & Assien, 2010). 85.9% respondents were detected with refractive error, making a 13.3% prevalence. Myopia, hyperopia and astigmatism prevalence were 5.0%, 1.7% and 6.6% respectively; and visual impairment (VA of 6/12 or worse in the better eye) was present in 4.5% of the children examined.
Msiska et al (2008) conducted a cross-sectional community based among 1448 12 to 15 year olds urban Lilongwe primary school children to determine the prevalence and pattern of significant refractive error. Respondents who failed VA of 6/12 were subjected to both cyclopegic and subjective refractions. Refractive error was detected in 33 children, resulting in 2.3% prevalence, and myopia, hyperopia and astigmatism distribution were 1.7%, 0.4% and 0.3% respectively. Although only 9%, i.e. 3 out of 33 children with significant refractive errors were wearing spectacle correction, the researchers concluded that prevalence of significant refractive error was low to justify a regular school screening programme.

In South Africa, 4890 children ranging from 5-15 years of age were examined during the Refractive Error Study in Children conducted in Durban (Naidoo et al., 2003). Following the RESC protocol, the examination of this “Refractive Error and Visual Impairment in South African children” door-to-door survey involved visual acuity measurements, cycloplegic auto-refraction and retinoscopy which are essential to estimate refractive error prevalence and to identify the pattern of such refractive errors; and the anterior segments, ocular media and the fundus were examined and the ocular motility were assessed to determine any other possible causes of visual impairment (Naidoo et al., 2003). In this survey Naidoo et al.(2003) estimated that of 191 eyes with reduced vision, 63.6% had refractive errors. In essence, of the 1.4% respondents found with refractive errors, only 1.2% of children had refractive correction and 0.32% had best-corrected visual acuities of 20/40 or less, thus they were visually impaired (Naidoo et al., 2003). Naidoo et al.(2003) had noted that there was 7.3% amblyopia prevalence, retinal disorders in 9.9% and 3.7% prevalence of corneal opacity. It was concluded that although reduced vision is low, most of it was due to uncorrected refractive error (Naidoo et al., 2003).

However another South African study on refractive status of primary school children, conducted in Mopani District – Limpopo Province comprised of 388, 8 to 15 year olds respondents (Mabaso et al., 2006). Auto-refraction was performed together with the non-cycloplegic retinoscopy and with the VA cut-off of 6/10, log Mar visual acuity measurements were taken; but auto-refractor readings were discarded and the overall
study findings were based on visual acuity and retinoscopy. Poor vision was reported in 3.1%, with 99.5% eyes improving VA to 6/7.5 or better with pinhole and retinoscopic correction; thus refractive error was the cause of poor vision (VA of 6/10 and less) in 99.5% eyes (Mabaso et al., 2006). Prevalence of hyperopia, astigmatism and myopia were reported as 73.1%, 31.3% and 2.5% respectively (Mabaso et al., 2006). Mabaso et al.,(2006) also noted that none of the respondents wore spectacles or any optical corrective means. While the KZN RESC applied the VA cut-off of 6/12, the Limpopo study used log Mar VA of 6/10; and Mabaso et al.,(2006) argued that differing screening methodologies could have resulted in different prevalence. Yet there could be other reasons for varying prevalence, hence it is necessary that refractive error studies are conducted for different communities at various geographical areas.

2.3. Age and gender on refractive errors

Before making any attempt in determining if there is any association between uncorrected refractive errors and demographic variables, it was deemed necessary to gain insight on the findings of earlier investigators on the subject.

Several investigators in human vision made attempts in establishing any significant association to the development of refractive error. Thus this section is formulated to review if such researchers managed to establish any association between demographic variables such as participants’ gender and age and the corresponding refractive errors status.

While reporting their findings in São Paulo, Brazil, Salomâno et al. (2008) asserted that there was no significant association of visual impairment due to refractive error with gender, age or grade level. However, in their study to prove the necessity of including refractive error tests in vision screening among children, Fotouhi et al (2011) reported that although there was no significant correlation between myopia and age, a nonlinear decrease of hyperopia prevalence with age was noted.

On a cross-sectional comparative study conducted in Northern Ireland, O’ Donoghue et al (2010) aimed to describe the prevalence of refractive error and visual impairment among two age groups; the 6 -7 year olds (n = 392) and 12-13 (n= 661). Defining the visual
impairment as the visual acuity of worse than 6/12, O’Donoghue et al (2010) reported the respective hyperopia and myopia prevalence of 6% and 2.8%, and 14.7% and 17.7% for 6-7 year olds and 12-13 year olds. O’Donoghue’s results indicate that the older group is more susceptible to refractive error, hence are more prone to poor vision.

On a refractive error prevalence study in German children, adolescents and adults, Jobke et al (2008) had noted an interesting refractive error shift with age. No myopia was found among the 2 to 6 years of age German children, yet 9.8% of those children had hyperopia. Among 7 to 11 years of age children, 5.5% were detected with myopia, whereas 6.4% had hyperopia; on the other hand among the adolescents (12 to 17 years respondents) 21.0% were detected with myopia while only 3.7% of this age group had hyperopia. At 23.6% refractive error prevalence in female respondents, Jobke et al (2008) noted this as significantly higher than the 14.6% prevalence in their male counterparts.

Pi et al (2010) noted a gradual change of hyperopia and myopia from the positively-skewed refractive error to negatively skewed pattern, i.e. younger children found to be more hyperopic while myopia became more prevalence among the older children. Pi et al (2010) added that the age of 9 years seem to be critical for such changes. Although Pi et al (2010) reports no significant effect of gender on individual refractive errors, it was concluded that girls were slightly more prone to refractive error than their male counterparts.

In southern China, He et al. (2007) agreed with Pi et al (2010) on the correlation of age and myopia, and even went further to demonstrate that it affected 36.8% of 13-year-olds, increasing to 53.9% of 17-year-olds; however, the former reported that astigmatism and hyperopia were evenly distributed among all age groups and their prevalence were 25.3% and 1.0% respectively. Like Pi et al (2010), He et al (2004) noted higher hyperopia prevalence among the younger group and vice versa, yet he concurs with He et al, (2007) on the distribution of astigmatism.

Thus the three above-mentioned researchers in China noted an overall high prevalence of myopia, which tend to become worse with advancing age, and both He et al, (2007) and He et al (2004) report a significant association of myopia with female gender, adding higher parental education and schooling in the county urban center as the risk for developing
myopia. Another Thailand study - the Thailand’s Refractive Error Study in Children (RESC) also reported myopia prevalence which seems to progress and get worse in older children (Yingyong, 2010).

This age myopic shift was also confirmed by Murthy (2002), in New Delhi who reported hyperopia as more prevalent of the refractive errors, and also associating hyperopia with female gender. The age-related refractive error shift noted by Murthy et al (2002), was in such a way that hyperopia decreased from 15.6% among the 5 year olds to 10.8% among the 15 year olds.

However, still in India, Padhye et al. (2009) noted that 13 to 15 years old urban respondents were most likely to be affected by myopia, thus advanced age or adolescents are prone to developing myopia. Another Indian study, a cross-sectional conducted in Kolkata noted that girls were generally associated to a higher prevalence of refractive error (Ghosh et al, 2012).

This was earlier noted by Al Rowaily & Alanizi (2010) who reported a significant gender difference in refractive error difference whereby female respondents were found to be more prone to suffer from refractive errors, with the prevalence of 11.7% in girls as compared to 8.3% in boys. However probably with the participants being more of the same age group (i.e. 12-13); Al Rowaily & Alanizi (2010)’s prevalence of uncorrected refractive errors among adolescents at King Abdul-Aziz Medical City, Riyadh, Saudi Arabian study could not establish if age might be a factor for developing refractive errors.

Among the 7 to 15 multi-ethnic Malaysian school age children, Goh et al (2005) reported that myopia was lower in 7 years of age and it was higher in the 15 years old respondents; and it was associated with older age, female gender, higher parental education as well as Chinese ethnicity. And hyperopia was associated with younger age and other ethnic groups. While Alam et al (2008) reported that refractive error prevalence has a strong relationship with gender, being predominant in girls; they argued that there was no association found between age and the prevalence of refractive errors. This may not come as a surprise considering the fact that the mean age of the participants was 9.49± 2.5 (Alam et al, 2008).
Although the Ethiopian school-based study had more boys at 53.6%, a greater proportion of girls was found to be affected by refractive errors as compared to boys, Mehari & Yimer (2013) reported girls as more likely to have uncorrected visual acuity of 6/12 or worse. Despite the wide range of respondents’ age (i.e. 7 to 18 years) in this school-based study; Mehari & Yimer, (2013) makes no mention of any association between refractive error and age.

In the Cape Cost Municipality in the central region of Ghana Ovenseri-Ogbomo & Omuemu (2010) also noted the association between refractive error and age, adding that hyperopia was most common among the 5 to 7 years of age respondents, yet it declined from 10.4% among this age group to 0% among the 17-19 teens, whereas myopia increases from 0.9% among 5 – 7 years old to 12.5% among the 17 -19 age group.

In South Africa, the findings by Naidoo et al (2003) also indicated that myopia was the common refractive error, and it also was associated with advanced age as well as with increased parental education. Yet no gender associations were established in the study. Even though the Mopani district indicated hyperopia prevalence as significantly higher than that of myopia, the former was reported to have a tendency of decreasing with advancing age while the later increases, confirming that advancing age is a significant risk for developing myopia among school children (Mabaso et al., 2006). At 31.3% prevalence, the study has reported astigmatism to be higher in male respondents than their counterparts.

2.4. Barriers to correcting refractive errors

It was pointed-out in the introductory chapter that most of the school children referred to the researcher’s workplace by the Gauteng school health nurses had uncorrected refractive errors. Since knowledge on the barriers is necessary in planning for service delivery; the focus of this section will be to review prior researchers’ work on possible reasons for the refractive errors to remain uncorrected.

On the subject of barriers to refractive error correction, He et al (2005) had realized that although uncorrected refractive error is recognized as the principal cause of visual
impairment in school children; and that correction of refractive error is easy, safe and effective; many children remain without necessary spectacles or other forms of corrective devices.

Below are some of the possible barriers which might hinder the correction of refractive errors – and lead to visual impairment.

2.4.1. Lack of awareness

While investigating the global magnitude of visual impairment due to uncorrected refractive errors, Resnikoff and co-investigators (2008) realized that even in economically advantaged societies, it is likely that refractive errors remain undetected or uncorrected in children.

World Health Organization (2001) cites lack of public awareness on the importance of eye care and of the availability of vision correction as a possible barrier - leading to uncorrected refractive errors. Resnikoff et al, (2008) elaborated that lack of awareness and recognition of a visual problem is at personal and family levels, as well as at community and public health levels. The Sight First Long Range Planning (SFLRP) working group agrees that refractive error may not be addressed because of lack of awareness or recognition by individuals or family. Of which children tend to be particularly vulnerable to lack of awareness as they may fail to articulate the extent of their problem.

2.4.2. Refractive service availability, accessibility and affordability

On the World Health Organization bulletin, Dandona and Dandona (2001) reported that providing spectacles was a challenge in many developing countries because of issues related to availability and affordability; adding that there were inequalities in the availability of optical services in urban and rural areas. And the World Health Organization (2001) added that most area lack eye care personnel and/or the equipment needed to perform refraction are unavailable. Although the 2001 World Health Organization bulletin is over a decade old, its content still hold true to the most rural South Africans.
World Health Organization (2001) also noted that services, or the spectacles needed to correct vision may be inaccessible or unaffordable to the community in need. Naidoo et al (2010) estimates that only 20% of those requiring distance visual correction have access to spectacles in the developing countries. Of which on their “Uncorrected Refractive Error position paper”, the SFLRP working group also cite that there is limited availability or affordability of refractive error services as well as glasses.

While the Christian Blind Mission (CBM) pointed-out that although refractive error and visual impairment are easy to diagnose and correct with the corresponding means, in many of the poorer communities; the costs are insurmountable barriers for those in need of refractive services and respective devices. Marmamula et al (2011) conducted a population based cross sectional study on barriers to utilization of refractive error services in India, and reported that 94% of respondents with uncorrected refractive error cited affordability as the main barrier to the uptake of eye care services. The same sentiments were shared by 43% Pakistan respondents on a study facilitated by the Sight Savers International as they said they could hardly afford more than three United States dollars for a pair of glasses. This may be particularly significant for children because such glasses may require frequent replacement due to breakage.

2.4.3. Cultural-inclined issues and lack of compliance

WHO (2001) and the SFLRP working group had noted that in some countries, there are cultural stigmas that discourage the use of spectacles; which tend to lead to non-compliance. In Pakistan Sight Savers International conducted several studies into community perception of refractive errors; of which they found that refractive services and spectacle costs were not the only key barriers to children wearing glasses, but also that those children were concerned about the appearance. And Ovenseri –Ogbomo & Assien (2010) observed that children with refractive error are less likely to opt for spectacles/eye glasses until they are significantly visually impaired that they have difficulty performing specific visual tasks. And parents who may perceive that that their children are too young to be wearing spectacles tend to make matters worse.
In South African, Ntsoane and co-investigators (2012) investigated the utilization of public eye care services by the rural community residents of Capricorn district in Limpopo province, and their findings concur with the international researchers as they also noted that non-availability, poor accessibility of services, non-affordability, poor knowledge of available services as well as cultural-inclined issues as some of the barriers preventing communities/people from utilizing eye care services.

2.5. Concluding remarks
There is dearth of refractive error data in South Africa. Yet the available literatures reveal considerable geographic and ethnic variations in prevalence and distribution of ocular refractive errors among school children in different populations. Different methodologies have been applied by different researchers. Hence their findings cannot be generalized for all areas and ethnic groups.

Remaining uncorrected, refractive errors could have short- and long-term consequences. Yet the use of ocular refractive error corrective devices can prevent vision loss (Al Rowaily & Alanizi, 2010). And to address the burden of uncorrected refractive error, Marmamula et al (2011) emphasizes that provision of refractive services is as important as the utilization of such services.

Therefore education and promotion of eye care services in communities, visual screening programme (especially in schools), strong emphasis on provision and utilization of optical correction for those detected with correctable ocular refractive errors is highly recommended.
CHAPTER THREE: METHODS

3.1. Study design
A cross-sectional study was designed and conducted to investigate the prevalence of uncorrected refractive errors, distribution of the types of uncorrected refractive errors, to determine if there is any relationship between age and gender, and refractive errors of the target population, and to investigate possible barriers for not utilizing refractive error corrective devices among primary school children who have uncorrected refractive errors in Moretele area, North-West Province of South Africa.

3.2. Study population
The study population comprised of the primary school children of Moretele area in North-West province of South Africa.

3.3. Sampling method
Cluster random sampling method was used to select the study sample. Permission to conduct the study was sought from Moretele Department of Education Area Office manager. The area office manager granted the permission to conduct the study and even wrote corresponding letters to the respective principals of the randomly selected schools.

Moretele Area Office consists of Makapanstad Central, Makapanstad North, Makapanstad West, Rekopantswe and Tswaing sub-districts. There were about 90 primary schools among these sub-districts and approximately 35 000 school children (North-West Department of Education, 2009).

The sub-districts were considered as the primary sampling units – clusters. Makapanstad Central, Makapanstad North, Makapanstad West and Rekopantswe sub-districts, were selected using random sampling (Ahmed, 2009). Within the selected clusters, primary schools were considered as the secondary sampling units (Ahmed, 2009). To improve the representativeness of the sample to the target population within the Moretele area,
Mphebatho Primary School was selected from Rekopantswe sub-district, Dikeledi Makapan Primary school from Makapanstad Central, and from Makapanstad West sub-district, Rantebeng Makapan and Thloloe primary schools were also selected using random sampling (William, 2006). From Makapanstad North, Swarisanang Primary School was selected; however the researcher used it for a pilot study in October 2012.

Since the sample frame is a group of individuals who have a real chance of being selected for the study sample (Castillo, 2009), grade 3, 4, 5, 6 & 7 children made the sample frame. Children in these grades were anticipated to participate in the study; hence both pediatric assent and parental consent forms were given to all learners within the sample frame. However, only those from whom the signed consent forms were obtained were considered as valid respondents. The study had 476 respondents.

Visual screening was conducted at the randomly selected schools to identify respondents who have poor vision. Those who were detected with poor vision were referred for comprehensive optometric visual examination at a local optometrist (the researcher’s workplace). The researcher gave list of the referred respondents to the school authorities. The parents/guardians of the respondents who proceeded to phase two of data collection were informed that further investigations were necessary and that were to be done at the researcher’s workplace at no cost to the respondents. Two Dikeledi Makapan Primary school children, who are from the same family, were denied further participation by their guardian (grandmother).

The comprehensive optometric visual examination was used to differentiate respondents who have poor vision due to uncorrected ocular refractive errors as opposed to those who have poor vision due to other causes. The comprehensive optometric visual examination was also used as a method to identify and measure the magnitude of different types of refractive errors; as this was necessary to determine the distribution of these errors.

3.4. Inclusion and exclusion criteria

Inclusion criteria: Grades 3, 4, 5, 6 & 7 school children were considered for a sample frame. At this stage children were found to be confident in identifying numbers and letters as opposed to most of the grade 0 to 2.
**Exclusion criteria:** Primary schools without grade 7, schools for the blind and the deaf children were also excluded. Grade 0 to 2 school children were excluded.

### 3.5. Sample size

A minimum sample of 384 primary school children was estimated using the following formula:

\[
\text{Sample Size} = z^2 \times p \times \frac{(1-p)}{c^2}
\]

Where \( z \) value is 1.96 for 95% confidence level, percentage picking choice \( p \) is 50%, expressed as a decimal, 0.5 is used for sample size needed; \( C \) being the confidence interval, also expressed as a decimal, 0.05 ±5 for this study (WHO, 2007).

Estimated Sample Size = \( 1.96^2 \times 0.5 \times \frac{0.5}{0.0025} = 3.84 \times 0.5 \times 200 \approx 384 \).

A total of 476 legible respondents participated in the visual screening at their respective schools.

### 3.6. Study settings

The study had two settings, thus it comprised of two-phased data collection. The first setting was at the randomly selected primary schools, where visual screenings were conducted in order to collect visual acuity data from the respondents; while the second setting was at the researcher’s workplace, a local private optometric practice where comprehensive refractions and eye examinations were conducted.

### 3.7. Data collection methods & tools

#### 3.7.1. Pilot study

A pilot study was conducted to test data collection tool and the logistics of data collection procedures. Swarisanang primary school children, in the Makapan North (within Moretele sub-district), were selected for a pilot study.
The initial plan was to conduct vision screening at school to the possible portion of eligible respondents per day, and then proceeds to phase two of data collection with the referred few the next day; however the logistics proved to be less time and cost effective. Therefore all eligible children within the sample frame had to be screened, and based on their total number a vehicle (e.g. a taxi) was organized to transport them to phase two for refraction and eye examination. This scenario proved to be more cost effective and less disruptive to the learners and the teachers. To be time effective, the original (proposal) data collection tool was slightly edited, instead of taking pinhole visual acuities during vision screening at schools among respondents whose visual acuities were 6/12 or worse on at least one (either) eye; these respondents were referred to phase two of data collection and pinhole visual acuities were assessed during phase two data collection procedure.

3.7.2. Flow chart for data collection procedure
3.7.3. Vision screening at schools

The visual screening was the first phase of data collection. Visual screening procedures were conducted at the children’s respective schools. Empty classrooms were requested for each screening session and were granted by the respective school authorities. This procedure was conducted to identify respondents who have poor vision and who needed to be referred for comprehensive refraction.

Visual acuity was assessed to identify respondents whose vision is poor. A Tumbling -E visual acuity chart, a +100 spherical equivalent lens and a record card (a structured data collection tool (Appendix 1), were the tools used during the procedure.

Figure 3.1: Flow chart for data collection procedure
Although an assistant was required to present and to take assent from respondents with signed parental consent forms; the researcher (an experienced optometrist) was solely responsible for conducting visual screening test. The respondents were brought into the screening sites in groups of ten.

Each respondent was seated at a 6 meter distance from the visual acuity chart. The respondents were individually given instructions and requested to identify the chart readings. Each respondent was requested to alternatively cover one eye in order to assess and measure monocular visual acuities.

Visual acuity of equal to or less than 6/12 on either eye was used as the first referral criteria. Taking in consideration that hyperopic children may pass a visual screening test due to their actively accommodating eyes; a fogging test using a +100DS lens was utilized for those who passed the visual screening test. Through the +100DS, respondents were asked to read again. Respondents whose monocular visual acuities were still 6/9 or better through the fogging lens were also referred for refraction or for the comprehensive visual testing at a local private optometric practice – this was the second referral criteria. This was deemed necessary to increase the sensitivity of the visual screening procedure, particularly among the farsighted, who are notorious for excessive ocular accommodation as they could be easily missed by a mere visual acuity measurement.

3.7.4. Refraction and eye examination

This procedure was conducted by a qualified optometrist (the principal researcher) within the optometric practice settings. Standardized visual refractive tests were applied during the comprehensive visual testing to determined types and magnitude of refractive errors. A diagnostic set (retinoscope & ophthalmoscope), trial frame, a phoropter, pinhole, visual acuity chart and the record card (used during visual screening) were utilized during the procedure.

Case history for all children who proceeded to phase two of data collection was taken for each individual respondent. With the guidance of the data collection tool, respondents were also asked if they usually suffer from the visual/ocular complaints on the data collection tool. To assess validity of the phase one data collection – the visual screening test at schools; measurement of monocular visual acuities was repeated for all children who
proceeded to phase two data collection - each referred respondent and the ten non-referrals; and these Visual acuities were also assessed with the use of a pinhole among children who fail to identify letters on a 6/18 visual acuity chart line, and those whose visual acuity improves refractive error was indicated.

With the use of a trial frame and loose lenses and a retinoscope, non-cycloplegic retinoscopy was conducted as an objective test to estimate refractive errors. With the use of a phoropter, subjective refraction was conducted to refine the objective refraction findings. The findings were recorded on the data collection tool used during phase one of data collection.

Ophthalmoscopy was conducted to identify any respondents who have ocular pathology which might need to be referred to and assessed by an ophthalmologist, and respective findings were recorded on a data collection tool.

In relation to the given visual and/or ocular information given, respondents who were diagnosed with uncorrected refractive error were then asked the reason they were not in possession of corrective devices.

3.8. Reliability and validity

**Reliability** refers to the repeatability of the tests results and the findings thereof (Bonita et al., 2006). In this study repeatability was improved by using standardized clinical instruments/equipment/tools and data collection procedures (vision screening and refraction). Subjective refraction to verify and refine retinoscopy findings (objective procedure) was conducted.

**Internal validity** being the degree of which the results of an observation are correct for the particular group of people being studied (Bonita et al., 2006); in order to assess the internal validity of the vision screening test at schools, re-test -visual acuity measurements were repeated among fifty-two respondents who proceeded to phase two of data collection, forty-two referred children and ten of those who were initially considered to have had passed the vision screening tests at various schools. Thus 52 respondents (42 were referrals and 10 non-referrals) proceeded to phase two data collection; these were used to assess the internal validity of the vision screening test at schools.
42 respondents were identified as suspects of poor visual performance by the vision screening tests, however during the re-test within the optometric setting, 33 were actually found with poor visual performance whereas 9 children were found with reasonable good vision. Among the ten respondents who were identified by the vision screening tests as having good vision, one was actually found with significant refractive error.

Therefore the sensitivity and specificity were calculated as follows:

Sensitivity of screening tests : \( \frac{33}{34} = 97\% \); and the respective Positive Predictive Value to be 78.6\%, thus there is 78.6\% probability that those who were detected with poor visual performance by the visual screening tests at schools actually have poor visual performance; and

Specificity of the screening tests : \( \frac{9}{18} = 50\% \); with the respective Negative Predictive Value of 90\%, thus there is 90\% probability that school children who the vision screening tests found without poor visual performance, actually have no poor visual performance (Gordis, 2009).

**External validity** refers to the ability to generalize the study findings to the mother population (Bonita et al 2006). To improve external validity and to allow generalization of findings from the sample to the target population, cluster random sampling was applied (Clinical Epidemiology & Evidence-Based Medicine Glossary, 2010); the sub-districts were considered as the primary sampling units – clusters and random sampling was used to select primary schools within the randomly selected clusters (William, 2006), however all grade three through to grade seven school children were the potential study sample.

### 3.9. Bias

An important goal for this study is that the results are valid and could be generalized to the target population, therefore the issue of bias is addressed early in the study by ensuring that an appropriate study design is applied to carry-out the objectives (Houser, 2007). The importance of describing the process of respondent’s selection is apparent; and it was equally important to describe inclusion and exclusion for the study; and those who couldn’t make it due factors such discontinuing from participating, unwillingness to participate or absenteeism from school during the visual screening session (Houser, 2007).
3.10. Data analysis plan

Data were organized manually and “cleaned “by checking data transcriptions to ensure that they were complete. Data were entered into Microsoft Excel spreadsheet and imported to StataIC10 software for statistical analysis. The socio-demographics variables were summarized using descriptive summary measures: expressed as mean (standard deviation) for continuous variables (age), and percent for categorical variables (sex).

Pearson’s chi-square test was used to determine associations between categorical variables, and P-value of less than 0.05 is considered statistically significant.

3.11. Ethical considerations

Data were only collected after the University of Limpopo, MEDUNSA Research Ethics Committee (MREC) had granted permission. Permission to collect data from the randomly selected schools was requested and granted by Moretele Department of Education Area Office manager (Appendix 4), and school principals concerned (Appendix 5).

With strong emphasis on respondents’ voluntary participation, details of the study and the respondents’ rights to withdraw at any time were communicated (Coughlin, 2006). Free and voluntary informed consent was obtained from parents/guardians (Bonita et al., 2006); thus consent forms (in Setswana) were prepared and given to parents/guardians of the respondents to read, and to sign if they allow their children to participate in the study (Appendix 3B). As the study involves minors, local language informed consent was prepared specifying nature of the study in order to get assent from the respondents (Appendix 2B).
CHAPTER FOUR: RESULTS

4.1 Introduction
This chapter presents results of a quantitative data collected among 476 primary school children. Socio-demographic profile of the participants will be presented on the next section.
Refractive error prevalence data will be presented on the third section of the chapter, then the distribution of the uncorrected refractive errors among the participants, followed by the information on visual/ocular complaints as well as the possible barriers leading to the uncorrected refractive errors.

4.2 Socio-demographic profile
Moretele primary school children were sampled according to school grades, thus the sample frame comprised of grades three to seven. The randomly selected schools are public institutions which admit both genders, i.e. female and male children made the sample frame. The age of the respondents were found to range from eight to fifteen years.
Out of 729 possible sample, only 478 school children participated in the visual screening. The response rate for study was only 65.6%; however two referred children withdrew from participating further; thus the total number of willing and eligible participants was 476. Below is a tabulation of socio-demographic variables (in both frequencies and percentages);

Table 4.1: An overview of descriptive characteristics

<table>
<thead>
<tr>
<th>Socio-demographic variables</th>
<th>n(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>267(56)</td>
</tr>
<tr>
<td>Male</td>
<td>209(44)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>33(6.9)</td>
</tr>
</tbody>
</table>
4.2.1 Gender distribution of respondents

Both female and male, grade three to seven primary school children had an equal opportunity to participate in the study. The gender distribution of the participants is illustrated in percentages, as follows:

![Gender distribution of respondents](image)

**Figure 4.1:** Gender distribution of the respondents (N=476).
The above figure on gender distribution of the study participants, presents more than half 56% (n=267) female participants, while 44% (n=209) were male.

4.2.2 Age distribution of respondents
Age of each participant was recorded on the data collection tool. This was necessary for the study in order to determine if age has any association with refractive error status among the participants. Participants’ ages were recorded and analyzed in years. The age distribution of the respondents is displayed in both frequencies and percentages on the figure below.

![Age distribution of respondents](image)

**Figure 4.2: Age distribution of respondents (N=476).**
The participants ranged from 8 to 15 years in age, with the mean age of 10.9 ±1.7 standard deviation, 95% CI of [10.8 – 11.1]. While respondents who were 15 years of age are in the minority (n=8; 1.7%), those who were 10 to 12 years of age were in the majority, with both the 11 and 12 year olds equal at 97(20.4%) each age group. The 10 year olds were 93(19.5%), followed by those who are 9 years of age (69; 14.5%), then the 13 years (60; 12.6%), the 8 years old (33; 6.9%), and those who were 14 years (19; 4.0%).
4.2.3 School-grade distribution of respondents

The inclusion criteria of the study specified that the respondents would be selected according to the school grades. All grade three to seven primary school children had an equal opportunity of participating in the study.

**Figure 4.3:** School-grade distribution of the respondents (N= 476)

The above diagram shows the distribution of the study respondents according to school grades. 81(17.0%) of the participants were in grade three, 84(17.6%) in grade four, 103(21.6%) in grade five, grade six had the highest proportion of 24.4 % (n=116), and 92(19.3%) were doing grade seven.

4.3 Prevalence of uncorrected refractive errors

4.3.1 Definitions of refractive errors

For the study analysis, types of refractive errors, definitions, the minimum and maximum values as well as frequencies are tabulated below;
<table>
<thead>
<tr>
<th>Refractive Error</th>
<th>Refractive Error definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td>Defined as a Spherical equivalent of $\leq -0.50$ spherical dioptic power (DS)</td>
</tr>
<tr>
<td></td>
<td>Minimum value: -0.50 DS</td>
</tr>
<tr>
<td></td>
<td>Maximum value: -5.25 DS</td>
</tr>
<tr>
<td></td>
<td>Frequency: 14</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td>Defined as a Spherical equivalent of $\geq +0.75$ DS</td>
</tr>
<tr>
<td></td>
<td>Minimum value: +0.75 DS</td>
</tr>
<tr>
<td></td>
<td>Maximum value: +2.50 DS</td>
</tr>
<tr>
<td></td>
<td>Frequency: 13</td>
</tr>
<tr>
<td><strong>Astigmatism</strong></td>
<td>Defined as a Cylindrical power of $\leq -0.50$ cylindrical dioptic power (DC)</td>
</tr>
<tr>
<td></td>
<td>Minimum value: Plano/-0.50 DC</td>
</tr>
<tr>
<td></td>
<td>Maximum value: Plano/-2.50 DC</td>
</tr>
<tr>
<td></td>
<td>Frequency: 9</td>
</tr>
<tr>
<td><strong>Myopic astigmatism</strong></td>
<td>Defined as a Spherical equivalent of $\leq -0.25$DS and Cylindrical power of $\leq -0.50$ DC</td>
</tr>
<tr>
<td></td>
<td>Minimum value: -0.25 DS / -0.50 DC</td>
</tr>
<tr>
<td></td>
<td>Maximum value: -5.75 DS / -1.50 DC</td>
</tr>
<tr>
<td></td>
<td>Frequency: 18</td>
</tr>
<tr>
<td><strong>Hyperopic astigmatism</strong></td>
<td>Defined as a Spherical equivalent of $\geq +0.50$ DS and Cylindrical power of $\leq -0.50$ DC</td>
</tr>
<tr>
<td></td>
<td>Minimum value: +0.50 DS / -0.50 DC</td>
</tr>
<tr>
<td></td>
<td>Maximum value: +2.75 DS / -1.75 DC</td>
</tr>
<tr>
<td></td>
<td>Frequency: 11</td>
</tr>
<tr>
<td><strong>Emmetropia</strong></td>
<td>Absence of significant refractive errors. Between and inclusive of -0.25 &amp; +0.25 Dioptic Spherical power, and/or an equivalent of -0.25Cylindrical Diopter.</td>
</tr>
<tr>
<td></td>
<td>Frequency: 3 (among ametropic participants)</td>
</tr>
</tbody>
</table>
The above table presents the definitions of different types of refractive errors applied in the analysis.

### 4.3.2 Refractive status of the study sample (N=476)

Data of all eligible respondents were entered into excel spreadsheet and imported into STATA for analysis, and proportions on refractive status were determined, then frequencies and percentages were calculated. The findings are shown on the bar chart below.

![Refractive status of participants](image)

**Figure 4.4: Refractive status of the study sample (N=476)**

The above diagram presents 476 school children who were participants of vision screening at schools. Most of the respondents, 92.9% \( (n = 442) \) of the 476 school children were emmetropic (without refractive errors). Ametropia, significant refractive errors were detected in 34 children, giving an overall refractive error prevalence of 7.1%. Among those detected with refractive errors, one male participant (0.2%) was in possession of a pair of spectacles, presenting with monocular visual acuities of 6/12. Thus the prevalence of uncorrected significant refractive errors is 6.9% \( (n = 33) \). Of the 267 female respondents,
eighteen had uncorrected refractive errors, with the prevalent of 6.7%; however of the 209 male respondents, fifteen had uncorrected refractive errors, giving the prevalent of 7.2%

Among the ametropic respondents (n=34), five children had anisometropia (14.7%), i.e. there is a difference in refractive errors between the two eyes. For the study analysis, the anisometropia is defined as the difference of at least 1.00 dioptic powers.

Of the 65 eyes with poor visual performance; six eyes were amblyopic due to refractive errors. Including the only participant in possession of a pair of spectacles, five (1.0 %) of the participants have best-corrected visual acuities of ≤6/12 in at least one eye. Two participants (a female and a male) have binocular amblyopia (i.e. amblyopia in both eyes); two male school children have monocular amblyopia; whereas one participant (0.2%) had poor visual performance in one eye due to ocular pathology.

The respective prevalent of uncorrected, presenting and best corrected visual acuities of 6/12 or worse in at least one eye are 6.8%, 0.2% and 0.7%.

4.3.3 Magnitude of uncorrected refractive errors

**Figure 4.5:** Magnitude of uncorrected refractive error
The above diagram presents the magnitude of uncorrected refractive errors. The study detected refractive errors in 34 primary school children in Moretele sub-district, with a prevalent of 7.1%; however one child was in possession of refractive device - a pair of spectacles. Thus 97% (n=33) of these children had uncorrected refractive errors.

### 4.4 Distributions of refractive errors

#### 4.4.1 Proportions of refractive errors

Using the definitions provided in the previous section, the proportions of refractive errors were calculated and displayed as follows;

![Refactive error proportions](image)

**Figure 4.6: Proportions of refractive errors**

The above diagram presents the proportions of different types of refractive errors among the primary school children detected with ametropia. The study has found myopic astigmatism as the most prevalent refractive error (n= 18 eyes; 26.3%), followed by myopia at 20.6 % (n = 14 eyes), whereas 13 eyes (19.1%) were hyperopic. Hyperopic astigmatism was detected in 11 eyes (16.2%) of the participants. On the other hand, simple astigmatism
was detected in 9 eyes (13.2%). Among participants who were detected with refractive errors three eyes (4.4%) were emmetropic; thus there were three school children who were detected with ametropia only in one of their eyes. And among the three with monocular emmetropia, one participant's ametropic eye is also amblyopic. Thus the prevalent of myopic astigmatism, myopia, hyperopia, hyperopic astigmatism and astigmatism is 1.9%, 1.5%, 1.4%, 1.2% and 0.9% respectively.

4.4.2 Distribution of refractive errors by gender

To evaluate the distribution of different types of refractive errors by gender, both the demographic and refractive error data were entered into excel, imported into STATA and the output on proportions were determined.

![Gender distribution of refractive errors](image)

**Figure 4.7: Gender distribution of refractive errors**

The above figure displays gender distribution of different refractive errors among ametropic respondents. Myopic astigmatism is shown as the most prevalent refractive error among the participants (n=18, 26.3%); and more female respondents (n=12) were detected with myopic astigmatism as compared to their male counterparts (n=6). Of those
detected with myopia (n=14), 62.3% were male school children and 53.8% of those detected with hyperopia (n=13) were also male. Of those detected with hyperopic astigmatism (n=11), 54.5% were girls. And even more girls (n=7) were detected with simple astigmatism as compared to boys (n=2). The diagram also shows that 4.4% (n=3) of boys had emmetropia, thus refractive errors were only detected in one eye of these three male respondents (P-value = 0.05).

4.4.3 Distribution of refractive errors by age

The above diagram displays the distribution of refractive errors by the ages of respondents. As it is presented on the figure, almost a quarter (n=16; 24.6%) of the total (n=65) refractive errors was distributed among the 13 year olds children, whereas the 14 year olds (n=19) contributed 9.2% of the total refractive errors. Diagnosed with only myopia and myopic astigmatism, five eyes among the 15 year olds (n=8) had refractive errors. The 9 year olds were diagnosed with 16.9% (n=11;) constituting all other refractive errors.
except myopic astigmatism. Although the 10, 11 and 12 year olds were the majority respondents; they were only detected with the respective share of 9.2%, 15.4% and 10.8% refractive errors. Whereas 6.2% of refractive errors (n=65) was distributed among the 8 year olds (n=33), and this comprised only of hyperopia and myopic astigmatism.

4.4.4 Distribution of refractive errors by school grades

![Grade distribution of refractive errors](image)

**Figure 4.9:** School-grade distribution of refractive errors

The above diagram displays the distribution of different types of refractive errors according to school grades. The figure shows just over one-third (33.8%) of refractive errors distributed among grade seven school children, and myopic astigmatism (n=9) being more prevalent among these participants. Approximately a quarter (n=16; 24.6%) of the refractive errors is distributed among the grade 3 school children, while only 7.7% (n=5) were distributed among the grade four learners. However a gradual rise in refractive error proportions can be seen from grade five through to grade seven; with grade five carrying 12.3%(n=8) while grade six have a share of 21.5% (n=14).
4.5 Refractive error and socio-demographic variables

Female represents 56% (n=267) of the participants. To determine if there is any association between gender and refractive errors, Pearson chi-square and the odds ratio were calculated. Age of the respondents was categorized into two groups. The age groups were based on the mean, 10.9 years; hence the groups are 8-10 and 11-15. To determine the association between age and refractive errors, Pearson Chi-square and odds ratio were calculated. School grades were grouped in two groups i.e. 3-4 and 5-7; Pearson chi-square and odds ratio were also determined, the results are presented as follows:

Table 4.3 Tabulation of Odds ratio and Pearson chi-square on refractive error status and socio-demographic variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Odds Ratio(95%CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males vs. Females</td>
<td>0.87[0.43;1.75]</td>
<td>0.70</td>
</tr>
<tr>
<td>8-10year-olds vs. 11-15 year-olds</td>
<td>1.50[0.71; 3.13]</td>
<td>0.30</td>
</tr>
<tr>
<td>Grade 3-4 vs. grade 5-7</td>
<td>1.30[ 0.60; 2.78]</td>
<td>0.50</td>
</tr>
</tbody>
</table>

As displayed on the above table, the study finds no statistical significance between participants’ gender and refractive errors (P-value = 0.70 and odds ratio = 0.87 [95% CI 0.43-1.75]). Although the study found no statistical significance between participants’ age and refractive errors (P-value =0.30); 11-15 years old children were 1.5 times more likely to have refractive errors than the 8-10 years old group (OR=1.50 (95% CI 0.71 - 3.13). Similarly children in grades 5-7 were 1.3 times more likely to have refractive errors than those in grades 3-4 (OR=1.30 [95%CI of 0.60-2.78]); P-value= 0.50.
4.6 Visual/ocular complaints among respondents with uncorrected ametropia

To determine the proportion of respondents who had visual/or ocular complaints, children were individually asked to self report visual and/or ocular problems that they usually experience. The findings are tabulated in frequencies as well as in percentages below:

Table 4.4: The proportions of visual/ocular complaints among participants

<table>
<thead>
<tr>
<th>Visual/ocular complaints</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor vision</td>
<td>21(63.6)</td>
</tr>
<tr>
<td>Sore/painful eyes</td>
<td>11(33.3)</td>
</tr>
<tr>
<td>Watery eyes</td>
<td>10(30.3)</td>
</tr>
<tr>
<td>Sensitivity to light/wind</td>
<td>5(15.2)</td>
</tr>
<tr>
<td>Headache</td>
<td>4(12.1)</td>
</tr>
<tr>
<td>Red/swellings eyes</td>
<td>3 (9.1)</td>
</tr>
<tr>
<td>Itchy/scratchy eyes</td>
<td>2(6.1)</td>
</tr>
<tr>
<td>No visual/ocular complaints</td>
<td>1(3.0)</td>
</tr>
</tbody>
</table>

The above table presents the proportions of visual/ocular complaints among primary school children with uncorrected refractive errors. Some children reported more than one complaint. Poor vision was reported by 63.6%(n=21) ametropic respondents as a problem, while eleven (33.3%) reported sore/painful eyes, ten (30.3%) children complained of watery eyes; five (15.2%) of sensitivity to sunlight and wind; (12.1%) of headache; and 9.1%(n=3) complained of red swelling eyes, and two children(6.1%) diagnosed with uncorrected refractive errors mentioned that their eyes tend to be itching and/or scratchy eyes, However one child (3.0%) had no visual/ocular complaint.
4.7 Barriers to correcting refractive errors

Out of the total refractive error prevalence of 7.1 % (n=34), the study noted uncorrected refractive errors in 97% of these school children. Hence the study also investigated the possible barriers to the correction of refractive errors among the 33 respondents who had no corrective devices. The findings are presented on the figure below;

![Possible barriers to correcting refractive errors](image)

**Figure 4.10:** Possible barriers to the correction of refractive errors.

The above figure displays proportions of possible barriers leading to uncorrected refractive errors. The results show lack of awareness as the major barrier to correcting refractive errors (n=21; 63.63%); as compared to accessibility and/or affordability of refractive error services (n=10; 30.30%), cultural reasons preventing correction of refractive errors for one participant (3.03%); while one respondent (3.03%) mentioned no reason for not having corrective device.
CHAPTER FIVE : DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Introduction
South African’s National Department of Health is said to be committed to Vision 2020, the right to sight global initiative for the elimination of avoidable blindness (Maharaja, 2011). As part of school health services, some primary school children in provinces such as KZN and Gauteng also receive comprehensive eye care services. However similar services are not available for the primary school children in Moretele sub-district, in the North-West province, and there are no reported refractive error studies on these children.

Hence this study was conducted to investigate the prevalence of uncorrected ocular refractive errors, distribution of the types of uncorrected ocular refractive errors; to determine if there is any association between refractive error and demographic variables (age and gender); to also determine if the participants diagnosed with uncorrected refractive errors have visual/ocular complaints; as well as to investigate barriers for not utilizing refractive error corrective devices among primary school children who have uncorrected refractive errors in Moretele area, North-West Province of South Africa.

The current chapter will present the discussion on the main findings of the study. The concluding remarks will be drawn, and the recommendations based on the findings will be given.

5.1.2 Uncorrected refractive error prevalence
The study has noted 33 respondents with uncorrected refractive errors, giving an overall prevalent of 6.9%; with the respective prevalent for male and female respondents being 7.2% and 6.7%; therefore a slightly higher proportion of male school children were diagnosed with refractive errors. Prevalent of uncorrected, presenting and best corrected visual acuities of 6/12 or worse in at least one eye is 6.8%, 0.2% and 0.7% respectively. The only respondent(0.2%) with a pair of spectacles was also among the 0.7%, since the visual acuity of one of his eyes cannot be improved by mere optical means to better than 6/12 due to refractive amblyopia. 97% of respondents detected with refractive error were
in need of refractive correction, thus their refractive errors were uncorrected. The prevalent of different refractive errors is noted as 1.9%, 1.5%, 1.4%, 1.2% and 0.9% for myopic astigmatism, myopia, hyperopia, hyperopic astigmatism and astigmatism respectively. The study also noted 0.8% prevalence of refractive amblyopia, presenting with visual acuities of 6/12 or worse in at least one eye.

Despite the difference in methodologies, the burden of uncorrected refractive errors in South Africa was also noted over ten years ago by Naidoo et al. (2003), who reported that only 1.2% of children in Kwa-Zulu Natal were actually in possession of refractive error correction, thus 98.8% of children in need were without corrective devices. Naidoo et al. (2003) also reported 7.3% amblyopia prevalence. On primary school children’s refractive status study conducted in Mopani district, Mabaso et al. (2006) also noted that over 99% of children diagnosed with poor vision had uncorrected refractive errors.

5.1.3 Socio-demographic profile and refractive error distribution

While both female and male primary school children of Moretele sub-district in North West Province had an equal opportunity to participate in the study, girls represented 56% of the study sample (N=476); and more than half of eyes diagnosed with uncorrected refractive errors are those of female respondents; however a higher proportion of male respondents 7.2%(15/209) had uncorrected ametropia. Of the 18 eyes diagnosed with myopic astigmatism, two-third was those of girls’. More than half of hyperopic eyes, as well as 77.8% of eyes diagnosed with simple astigmatism also belonged to female respondents. Almost two-third of myopic eyes (64.3%) and more than half hyperopic eyes (53.8%) are those of male respondents.

Nonetheless the findings indicate no statistic significant correlation between gender and refractive error prevalence among primary school children of Moretele sub-district (P-value = 0.70; odds ratio = 0.87 [95% CI 0.43-1.75]). Although this is in agreement with the findings in São Paulo among the Brazilian children (Salomâno et al, 2008); in an Ethiopian school-based study Mehari & Yimer (2013) reported a higher prevalence of refractive errors among girls.
Participants’ ages were recorded and analyzed in years. Their ages ranged from 8 to 15 years, mean age 10.9 [standard deviation of ±1.7] years. Based on the mean the respondents’ ages were categorized in two groups, i.e. 8-10 and 11-15 years. This was necessary for the study in order to determine if age has any effect on having refractive error among the respondents. Those who were 10 to 12 years old made the majority and the 15 year olds were the minority (n=8; 1.7%). Yet contributing to the 7.7% of total refractive errors, almost a third (31.3%) of eyes among the 15 year olds was diagnosed with refractive errors, and these refractive errors comprised only of myopia and myopic astigmatism. While the 14 year olds contributed to 9.2% of total refractive errors; 13.3% of eyes among the 13 year olds (n=60) were ametropic, and all types of refractive errors were dispersed throughout the later group. 6.2% of refractive errors among the 8 year olds increased to 16.9% among the the 9 year school children, and then declined to 9.2% among the 10 year olds. The 11 and 12 year olds contributed the respective refractive errors of 15.4% and 10.8%.

The study found no statistically significant correlation between participants’ ages and refractive errors (P-value= 0.30); and participants’ ages were found to pose no risk to having refractive errors (odds ratio 1.50 [95% CI 0.71; 3.13]). Although the findings on lack of association between age and refractive errors are in-line with those reported by Alam et al (2008); they differ from the findings by O'Donghue et al., (2010) among Irish children in Ireland, as well as the findings by Ovenseri-Ogbomo & Omuemu (2010) among children of Cape Cost Municipality in Ghana.

Grade six learners represented almost a quarter of the respondents (n=116; 24.4%). The other four grades carried smaller quantities of the respondents, with grade three learners representing the least at 17% (n=81). However, grade three school children carried almost a quarter (24.6%, 16/65) of refractive errors, which is evenly distributed among these learners. Refractive error distribution gradually increased from grade four to grade six; with grade four, five and six carrying respective portions of 7.8%, 12.5% and 18.8%. With a total of 92 respondents- 33.7% 12 year olds, 45.7% 13 year olds, 14.1% 14 year olds and 6.5% 15 year olds; more than one-third of total refractive errors was spread among the
grade seven school children and 35% (8/23) of these errors was due to myopic astigmatism.

The study found no statistically significant correlation between school grades and refractive errors (P-value = 0.50); and school grades were found to pose no risk to having refractive errors (Odds Ratio 1.30 [95% CI of 0.60 to 2.78]) among primary school children of Moretele sub-district. This finding concurs with the finding reported in São Paulo, Brazil (Salomâno et al, 2008).

5.1.4 Barriers to correcting refractive errors

Almost all respondents diagnosed with uncorrected refractive errors (97%) indicated that they usually have one or more complaints related to their vision and/or ocular health, however almost two-third of these school children were not aware that there could be a need for them to wear spectacles in order to alleviate their respective problems. 30% of these children had previously indicated their respective complaints to either their parents or guardians, however some were sent to local clinics were little help was offered, whereas some were told that they will be sent to a doctor when the resources are available. The only female amblyopic child had owned a pair of spectacles; however this pair broke over a year before the study was conducted. Therefore while lack of awareness seems to be prominent, accessibility and affordability of refractive services also standout as barriers to correcting refractive errors among the respondents.

On lack of awareness, Sithole and Oduntan (2010) observed that eye care coordinators in a number of South African provinces are not necessarily concerned with eye health promotion, and also noted that there are significant disparities between provincial infrastructures.

5.2 Limitations of the study

With regard to the design for this study, cycloplegia was not utilized during either phase of data collection; however to account for accommodation which is a common phenomenon among young children, a +1.00 spherical equivalent fogging lens was used to further assess
monocular visual acuities among children who could see better than 6/12 line during the vision screening procedure at schools.

The response rate of the study was good at 65.6%. Two of the referred respondents withdrew from proceeding to phase two of data collection. It is possible that with this level of response rate, the prevalence of refractive errors could be different if higher level of response rate was attained, particularly if the non-responders may have been of different characteristics from the study respondents.

Considering that the respondents were minors, it would have been more insightful to obtain data on the possible barriers for correcting refractive errors from the parents or guardians of the respondents.

5.3 Conclusion
The study found on an overall refractive error prevalence of 7.1%. Myopic astigmatism was noted as the most common refractive error, followed by myopia, hyperopia, hyperopic astigmatism, then simple astigmatism. A significant finding is that an alarming proportion (97%) of these refractive errors were uncorrected because these children were not receiving care services as part of the school health program as it is done in other areas in South Africa. Although no significant association was found between refractive errors and demographic variables; lack of awareness is indicated as the main reason refractive errors remain uncorrected among the respondents.

5.4 Recommendations
There is need for the School Health Program to be introduced urgently in Moretele District so that properly planned and executed vision screenings can be conducted. School vision screening programme are necessary as they do not only help the children but also raise awareness on visual problems and other ocular anomalies in communities. More studies are required to understand the mechanisms underlying the increase of visual disorders with age.
REFERENCES


- 65 -

Sight Savers International, “Children who are blind or have low vision: findings from recent research supported by Sight Savers International” Accessed online http://www.sightsavers.org [23/8/2013]


APPENDIX 1

DATA COLLECTION TOOL

UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE AREA IN NORTH-WEST PROVINCE, SOUTH AFRICA.

<table>
<thead>
<tr>
<th>CLUSTER</th>
<th>NAME OF THE SCHOOL</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>RESPONDENT DEMOGRAPHIC DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESPONDENT DETAILS</td>
</tr>
</tbody>
</table>

PHASE ONE: VISUAL SCREENING AT SCHOOLS

DATE__________

SCREENING TEST-RESULTS:

<table>
<thead>
<tr>
<th>VISUAL ACUITIES</th>
<th>RIGHT EYE:</th>
<th>LEFT EYE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISUAL ACUITIES THROUGH +1.00 DS LENS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESPONDENT TO BE REFERRED FOR COMPREHENSIVE VISUAL TEST</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

IF YES, RESPONDENT ‘S NAME : ________________________________
# PHASE TWO: OPTOMETRIC COMPREHENSIVE VISUAL TESTING

**DATE:**

**VISUAL CASE HISTORY:**

<table>
<thead>
<tr>
<th>HEADACHE</th>
<th>SENSITIVITY TO LIGHT/WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITCHY/SCRATCHY EYES</td>
<td>SORE/PAINFUL EYES</td>
</tr>
<tr>
<td>POOR VISION</td>
<td>WATERY EYES</td>
</tr>
<tr>
<td>RED/SWELLING EYES</td>
<td>NO VISUAL/OCULAR COMPLAINTS</td>
</tr>
</tbody>
</table>

**HISTORY OF PRIOR VISION TESTING:**


**UNAIDED VISUAL ACUITIES**

<table>
<thead>
<tr>
<th>RIGHT EYE</th>
<th>LEFT EYE</th>
</tr>
</thead>
</table>

**PINHOLE VISUAL ACUITIES:**

<table>
<thead>
<tr>
<th>RIGHT EYE</th>
<th>LEFT EYE</th>
</tr>
</thead>
</table>

**PROCEDURE**

<table>
<thead>
<tr>
<th>RETINOSCOPY</th>
<th>RIGHT EYE FINDINGS</th>
<th>VA</th>
<th>LEFT EYE FINDINGS</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBJECTIVE REFRACTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FINAL OPTICAL PRESCRIPTION</td>
<td>RIGHT EYE:</td>
<td>LEFT EYE:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OPHTHALMOSCOPY & EXTERNAL EXAM:**

**DIAGNOSIS:**

**HISTORY OF PRIOR REFRACTIVE DEVICE USE:**

**IF NONE, REASON:**

<table>
<thead>
<tr>
<th>LACK OF AWARENESS</th>
<th>ACCESSIBILITY/AFFORDABILITY</th>
<th>CULTURAL REASONS</th>
<th>NO REASON</th>
</tr>
</thead>
</table>

**RECOMMENDATIONS:**

**NOTES:**

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APPENDIX 2A

UNIVERSITY OF LIMPOPO (MEDUNSA CAMPUS) PEDIATRIC ASSENT FORM

Statement concerning participation in a Research Project:

UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE AREA IN NORTH-WEST PROVINCE, SOUTH AFRICA.

(Child to read aloud. If unable to read, the presenter should read to the child.)

I understand in this research my eyesight will be checked.

I understand my Mom/Dad/Guardian has said it is ok for me to participate in the research.

I understand I can only be in this research on my free will.

I have been told that I can stop participating in this research anytime I want to.

I have had my questions answered and know that I can ask questions later if I have them.

I have been told that the results of this research will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I have read this information (or had the information read to me).

I agree to take part in the research.

..................................................................................................................

Name of child ........................................ Signature of child ................. Date ................ Place ................

Copy provided to the participant. Parent/guardian has signed an informed consent.

________(initialed by researcher/person taking the assent)

..................................................................................................................

Name of person taking the assent (researcher/assistant) .. Signature .... Date ........

Statement by the Researcher
I have read or witnessed the reading of the assent form, and written information regarding this study is provided to the potential participant. Individual had the opportunity to ask
questions & I agree to answer any future questions concerning the study as best as I am able. I confirm that the individual has given assent freely. I will adhere to the approved protocol.

......................................       ......................................       ......................................       ..............................................................

Name of Researcher    Signature    Date    Place
APPENDIX 2B

UNIVERSITY OF LIMPOPO (MEDUNSA CAMPUS) SETSWANA PEDIATRIC ASSENT FORM

Seteiteme se se ka ga go tsaya karolo mo Porojeke ya Patlisiso.

UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE AREA IN NORTH-WEST PROVINCE, SOUTH AFRICA.

(Ngwana o letleletswe o buisa. Ge a sa kgoni u buisa, motho a tsayang tomellano o tla buisetsa)

Ke tlhaloganya gore mathlo a me a tla tlhatlhabiwa go netefatsa gore a bona sentle kgotsa nyaa.

Ke tlhaloganya gore mme/ntate/motlamedi o dumetse gore gosiame gore ke tsaye karolo mo patlisiso e.

Ke a tlhaloganya gore a go tuelo epe mo patlisisong e.

Ke a tlhaloganya gore nka ikogela morago mo go yona ka nako e nngwe le e nngwe kwa ntle ga go neela mabaka.

Ke filwe monyetla oa go botsa dipotso le go fiwa nako e e lekaneng ya go akanya gape ka ntlha e.

Ke itse gore dipholo tsa patlisiso di tla dirisetswa mabaka a saentifiki e bile di ka nna tsa phasaladiwa.

Ke dumelana le seno, fa fela go netefadiwa gore se e tla nna khupamarama.

Ke buisitse tsedimotsetso e (ka sedimotsetswa ka puiso e mo gonna)

Fano ke neela tumelelo ya go tsaya karolo mo patlisiso e.

........................................................    ....................................       ……………….     ………………………….

Leina la moithaopi Tshaeno ya moithaopi Letlha Lefelo
Moithaopi o filwe kgatiso e. Motsadi/motlamedi o kwetsi tshaenong go seteitemente sa tumellano ya gore moithaopi a tsaya karolo mo patlisisong e. _____(maemedi a mmatlisisi/motho a tsayang tomellano ya patlisiso e)

...........................................................................................................          ........................................

Leina la motho a tsayang tomellano (Mmatlisisi /mothosi)    Tshaeno
Lelha

____________________________________________________________

Seteitemente ka Mmatlisisi

Ke tlametse tshedimosetso ka molomo kgotsa ke ile ka paka ka go buisiwa ga tshedimosetso ya maithlomo le maikemisetso a patlisiso go moithaopi, le tshedimosetso e ekwadilweng malebana le patlisiso e e filwe moithaopi. Moithapi o filwe monyetla oa go botsa dipotso mme ke dumela go araba dipotso dingwe le dingwe mo nakong e e tlang tse di amanang le patlisiso ka moo nka kgonang ka teng.
Ke tla tshegetsa porotokolo e e rebotsweng.

...........................................................................................................          ........................................

Leina la Mmatlisisi    Tshaeno    Lelha    Lefelo
APPENDIX 3A

UNIVERSITY OF LIMPOPO (MEDUNSA CAMPUS) ENGLISH PARENTAL CONSENT FORM

Statement concerning participation in a Research Project:

UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE AREA IN NORTH-WEST PROVINCE, SOUTH AFRICA.

I have read the information on the aims and objectives of the proposed study and was given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurized into allowing my child participate in any way.

I know my child’s eyesight will be screened to assess if her/his vision is good or not; and that if the screening results indicate that his/her eyesight is poor, further eye tests will be conducted at a local optometrist to determine the reason for poor eyesight. I am aware that this material may be used in scientific publications which will be electronically available throughout the world. I give parental/guardian consent to this provided that my child’s name is not revealed.

I understand that my child’s participation in this study is completely voluntary and that she/he may withdraw from it at any time and without supplying reasons. This will have no influence on the assistance and care that she/he may need if her/his eyesight is found to be poor.

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

I hereby give consent for my child to participate in this study.

..............................................................................................................................
Name of parent or guardian

..............................................................................................................................
Signature of parent or guardian

..............................................................................................................................
Place. Date. Witness

Statement by the Researcher
I provided written information regarding this research.
I agree to answer any future questions concerning the research as best as I am able.
I will adhere to the approved protocol.

<table>
<thead>
<tr>
<th>Name of Researcher</th>
<th>Signature</th>
<th>Date</th>
<th>Place</th>
</tr>
</thead>
</table>


Seiteitemene se se ka ga go tsaya karolo mo Porojeke ya Patlisiso.

UNCORRECTED REFRACTIVE ERRORS AMONG PRIMARY SCHOOL CHILDREN OF MORETELE AREA IN NORTH WEST PROVINCE, SOUTH AFRICA.

Ke buisitse tshedimosetso ya maithlomo le maikemisetso a patlisiso e e rebotsweng mme ke filwe sebaka sa go botsa dipotsi le go fiwa nako e e lekaneng ya go akanya gape ka nthla e. Maithlomo le patlisiso e ke a thlalogantse sentle. Ga ke a pateletswa go dumella ngwana wa me go tseyya karolo.

Ke itse sentle gore matlho a ngwana wa me a tla tlathlobiwa go nnetefatsa gore a bona sentle kgotsa nnya. Ke a itse gore dipholo tsa dipholo tsa dipatlisiso di tla dirisetswa mabaka a saentifiki e e tla phatlaladiwang lefatshe lotlhe ka mokgwa wa elektroniki.

Ke thlloganya gore go tsaya karolo ga nwana wa me mo dipatlisisong tse ke boithaopo le gore a ka i kgogela morago nako e ngwre le e ngwre kwante le go fana ka mabaka. Se ga se kitla se nna le kgoretsetso epe mo kafaleng ya gawe fa go ka fithlhelwa pono ya gawe e e bokoa.

Ke a itse gore patlisiso e e rebotswe ke Patlisiso le Molao wa Maitsholo wa Khampase ya MEDUNSA -MREC, Unibesithi ya Limpopo (Khamphase ya MEDUNSA). Ke itse sentle gore dipholo tsa dipatlisiso tse di tla dirisetswa mabaka a saentifiki e bile di ka phasaladiwa. Ke dumellana le seo, fa fela leina la ngwana wa me le ka serelediwa.

Ke fana ka tumellano gore ngwana a ka tsaya karolo mo dipatlisisong tse.

.......................................................... ..........................................................
Leina ka motsadi/motlamedi. Tshaeno ya motsadi/motlamedi.

............................................... .............................................. ..........................................
Lefelo. Letlha. Paki

Seteitemene ka Mmatlisisi
Ke tlametse tshedimosetso ka molomo le/kgotsa e e kwadilweng malebana le Patlisiso. Ke dumela go araba dipotsi dingwe le dingwe mo nakong e e tlang tse di amanang le Patlisiso ka moo nka kgonang ka teng.
Ke tla tshegetsa porotokolo e e rebotsweng.

.......................................................... ..........................................................
Leina la Mmatlisisi Tshaeno Letlha Lefelo
The Area Office Manager
Moretele Area Office
Makapanstad (North-West Province)

Dear Madam/Sir

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I, Priscilla Ndou hereby request for permission to conduct a research at some of schools under your authority in Moretele Area.

I am a public health student at the University of Limpopo (MEDUNSA Campus), and I am also an Optometrist at Keevan Sher Optometrist in Temba City Shopping Complex. As a student I am required to conduct a public health research, and the topic of my research is: “Uncorrected ocular refractive errors among primary school children of Moretele area, North West Province, South Africa”. Granted permission, I would be conducting the study under the supervision of Prof. Malangu, a Public Health lecturer. Clearance certificate by the MEDUNSA Research Ethics Committee and the approved Research Proposal are attached.

My contact details are: Tel +27 12 717 4257 (w); Fax +27 12 717 4258; Cell 082 813 3713

Your assistance will be highly appreciated.

Kind regards

Signed__________

Priscilla Ndou (University of Limpopo (MEDUNSA) Student)
The Principal  
Mphebatho Primary School  
Rekopantswe Sub-district  
Moretele Area Office

Dear Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT MPHEBATHO PRIMARY SCHOOL

I Priscila Ndou hereby request for permission to conduct research at your school, Mphebatho Primary School. I am studying public health at the University of Limpopo (MEDUNSA Campus), and I am also an Optometrist at Keevan Sher Optometrist in Temba City Shopping Complex.

As a student I am required to conduct a public health research, and the topic of my research is: “Uncorrected ocular refractive errors among primary school children of Moretele area, North West Province, South Africa”. Granted the permission I would be conducting the study under the supervision of Prof Malangu, a Public Health lecturer. A clearance certificate by the MEDUNSA Research Ethics Committee and the approved Research Proposal are attached.

My contact details are: Tel +27 12 717 4257 (w); Fax +27 12 717 4258; Cell 082 813 3713

Your assistance will be highly appreciated.

Kind regards

Signed__________

Priscilla Ndou (University of Limpopo (MEDUNSA) Student)