KNOWLEDGE, ATTITUDE AND FACTORS INFLUENCING THE UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS AND EYECARE PRACTITIONERS IN LURAMBI CONSTITUENCY, KENYA.

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A thesis submitted to the School of Public Health, Biomedical Sciences and Technology in partial fulfillment of the requirements of the award of Masters ofOptometry and Vision Sciences at Masinde Muliro University of Science and Technology.

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This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for an award of a degree or any other award.

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DEDICATION

I dedicate this thesis to my parents and husband for their continuous support throughout the entire period.

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I take this opportunity to acknowledge God for giving me strength to complete this thesis. I would also like to appreciate Prof. Alvin Munsamy and Dr. Christine Wanjala for technical support in supervising this thesis. I acknowledge the contribution of Dr.Alfred Ragot for his tireless support and my colleagues for their continuous advice and guidance. I also extend my gratitude to Masinde Muliro University of Science and Technology, particularly the Department of Optometry and Vision Science for logistical support and for giving me the opportunity to undertake this academic endeavor.

ABSTRACT

The global rise in myopia has emerged as a significant public health issue, with 27% of the world population affected by 2020, and projections indicate that by 2050, nearly half of the global population will be myopic. Despite the increasing prevalence and the availability of effective myopia control strategies such as combination treatments, children with progressive myopia are often still prescribed single vision (SV) spectacles, which offer minimal to no control over myopia progression. This study aimed to evaluate the knowledge, attitude, and factors influencing the uptake of myopia control strategies among teenagers and Eye Care Practitioners (ECPs) in Lurambi Constituency, Kenya. An analytical cross-sectional design was employed, with 115 myopic teenagers and 22 ECPs purposively selected from 12 eye clinics in Lurambi Constituency participating. Teenagers completed a questionnaire assessing their knowledge, attitudes, and factors affecting the adoption of myopia control strategies, while ECPs responded to a questionnaire on their strategies and attitudes toward myopia management. The uptake of myopia control strategies among teenagers was 55.7%, with SV spectacles being the most commonly used at 70.3%, while none had used Ortho-K. Among ECPs, 86.36% had adopted effective myopia control strategies, with 84.2% prescribing SV spectacles, and Ortho-K was not prescribed. Knowledge of myopia control strategies was reported by 69.8% of teenagers and 100%of ECPs, with a significant relationship observed between knowledge and the uptake of myopia control strategies among teenagers (p-value <0.001). Good attitudes toward myopia control were reported by 48.3% of teenagers and 95.45% of ECPs. Cost emerged as the most influential factor in the uptake of myopia control strategies, affecting 79.7% of teenagers and 54.5% of ECPs. Increased cost was associated with a decreased likelihood of adopting myopia control strategies among teenagers, with an odds ratio of1.367 (95% CI [1.013-1.845]). Additionally, refractive error significantly influenced the uptake of myopia control strategies, with a p-value of 0.010 for teenagers and 0.031 for ECPs. The criteria for selecting an initial myopia control strategy in young myopes showed significant relationships with binocular vision status and other unspecified factors (p-values of 0.002 and 0.010, respectively). In conclusion, despite high levels of knowledge and positive attitudes toward myopia control strategies among both teenagers and ECPs, the actual uptake of effective myopia control strategies remains relatively low. The study found a significant relationship between knowledge and the uptake of myopia control strategies among teenagers (p-value ≤0.001) and identified cost as a critical barrier, decreasing the likelihood of adopting these strategies. Given these findings, the Ministry of Health of Kenya (Ophthalmic Division) is advised to develop a pediatric management guideline to support the utilization of myopia control strategies by ECPs in Kenya.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BF Bifocal.

CL Contact lens.

CM Centimeters.

D Diopter (unit of lens power measurement).

ECPs Eye care practitioners.

IERC Institution Ethics Review Committee.

IMI International Myopia Institute.

MCS Myopia Control Strategies

Min Minimum.

MMD Myopic Macular degeneration.

MMUST Masinde Muliro University of Science and Technology.

RE Refractive error.

RLRL Repeated low red light

SPSS Statistical Package for Social Sciences. SV Single vision.

WHO World Health Organization.

POPIA Protection of Personal Information Act

OPERATIONALIZATION OF TERMS

Attitude refers to individuals' feelings, beliefs and inclination towards various myopia control strategies.

Cycloplegic refers to drugs which dilates the pupil and temporarily paralyses the ciliary body.

Eyecare Practitioner refer to personnel who is trained and regulated and can diagnose and manage myopia.

Factors refers to various influences that affect the decision and behaviors of individuals regarding adoption and implementation of various myopia control strategies.

Knowledge refers to understanding and awareness of available methods, interventions and information to myopia control strategies.

Myopia is an eye condition where a patient sees objects at near clearly but not at far. A participant that had a spherical equivalent of ≤0.50 Ds in one eye or both eyes and astigmatism with myopic spherical power was diagnosed to having myopia.

Myopia control strategies are myopia management approaches that are used to stop myopia from processing.

Optometrist a healthcare professional who provides primary vision care, including sight testing, diagnosing vision changes, and prescribing corrective lenses. Optometrists generally hold a degree in optometry (Bachelor's or Diploma) but are not necessarily medical doctors.

Doctor of Optometry (OD) a qualified optometrist who has completed advanced studies, earning OD degree. This qualification allows for a broader scope of practice, including diagnosing and treating certain eye diseases, prescribing medications, and performing minor eye surgeries in some regions, depending on local regulation.

Refractive error is a problem with focusing light accurately on the retina due to the shape of the eye, axial length and or cornea.

Teenager a participant who was of the age of 13 to 19 years.

Uptake of myopia control strategies refers to willingness and readiness of individuals to adopt and implement various myopia control strategies.

Visual acuity is a measure of the ability of the eye to distinguish shapes and the details of objects at a given distance. This depicts the degree of sharpness of central (macular) vision.

Visual Impairment means that a person's eyesight is not clear or sharp as it should be, making it difficult for him or her to see objects clearly. In this case the patient has limited vision that makes him or her not do most of the activities independently.

CHAPTER ONE

1.0 INTRODUCTION

This chapter provides an overview of the study, beginning with the background on the increasing prevalence of myopia among teenagers and the importance of adopting myopia control strategies (MCS). It identifies the problem statement, highlighting the uptake of these strategies in Lurambi Constituency, Kenya, as the key issue that necessitated the study. The chapter outlines the study's objectives to explore the factors influencing MCS adoption and introduces the research hypothesis and questions. It justifies the study by emphasizing the need to address the growing burden of myopia, with the potential to inform public health strategies. Additionally, it defines the study's scope, acknowledges limitations, and clarifies delimitations, while presenting theoretical and conceptual framework to understand key variables.

1.1 Background

Myopia is a common refractive error (RE) condition (Foster and Jiang, 2014). Myopia is a disorder in which light focuses in front of the retina (Morjaria, 2019). Common symptoms of myopia include blurred vision when looking at a distant object, the need to squint (narrow the palpebral aperture) to see clearly and sometimes headaches (Muralidharan *et al.,* 2021) thus affecting the patient's academic performance and general life. In diagnosing myopia in children, cycloplegic retinoscopy and Mohindra retinoscopy (Ruiz *et al.,* 2022) are the objective methods used, even though cycloplegic retinoscopy remains the gold standard, due to its ability to completely paralyze accommodation (Ozdemir *et al.,* 2015). Consequently, cycloplegic refraction is crucial for obtaining precise refractive measurements when evaluating primary outcomes in myopia research (Wolffsohn *et al.,* 2019).

Intensive near work, limited outdoor activities and lifestyles have been associated with myopia onset and progression (Benz *et al.*, 2019; Pei-chang *et al.*, 2013; Wang *et al.*, 2022). Nevertheless, controversies exist among these studies on influence of outdoor activities, near work and lifestyles in myopia development. More so, different vision- threatening conditions ranging from cataracts, retinal detachment, myopic macular degeneration MMD (Santiago *et al.*, 2023), glaucoma and up to optic neuropathy have been linked with high (pathological) and progressive myopia (Enrique et al., 2021). Furthermore, the fact that the foregone vision-threatening conditions associated with high myopia are irreversible, vision impairment resulting from myopia thus places an increased burden on the quality of life of affected individuals and the healthcare system worldwide (Németh *et al.*, 2021; Sankaridurg *et al.*, 2021). The myopia burden has escalated dependence ratio since the affected population cannot work on their daily activities without additional support.

Differences in myopia prevalence in literature may be due to variability in age, age group and ethnicity of the different study populations (Rudnicka *et al.*, 2016; Verma *et al.*, 2017). A recent study reported that myopia affected 2.6 billion people globally (Németh *et al.*, 2021). A study among children and adults in Europe and North America estimated a myopia prevalence of 15% with an increase in myopia prevalence of 30% in Caucasians (Berke, 2021). Comparatively, another study found a prevalence of 41.9% for high myopia, with a myopia prevalence of 14.8% in children aged 5 to 7 years and 59% in children aged 17 to 19 years (Theophanous *et al.*, 2018). Asians have a high myopia prevalence compared to Caucasians whilst African Americans had a lower myopia prevalence (Berke, 2021; Grzybowski *et al.*, 2020; Theophanous *et al.*, 2018; Varma *et al.*, 2017. These studies highlight the stronger environmental influence on myopia development compared to genetic factors however, connection between myopia and environmental factors require more grounding research.

A study in Australia among disadvantaged Australian school children aged 5 years,

in the year 2014, 2016 and 2018 reported myopia prevalence of 3.5%, 4.4% and 4.3 % respectively (Reed *et al.,* 2020). There was an increase in myopia in Australia which could have been impacted by increasing education demands and urbanization. A review study between 2000-2021 on African school children aged 5 to 18 years found a myopia prevalence of 4.75% with a myopia prevalence of 3.4% in 5 to 11 years children and 5.1% in 12 to 18 years children (Ovenseri-Ogbomo *et al.,* 2022). In Africa, these prevalence studies may be perceived as low when compared to other continents such as Asia however, this may be owing to the larger rural footprint of African schooling or more controversial postulations that schooling systems in Africa are not vigorous. However, there is paucity of evidence on myopia and even prevalence across the continent and once this footprint is strengthened can one have proper consensus. Globalization may suggest Africans will eventually reach the larger prevalence of developed countries thus if behavior is changed now this may mitigate myopia progression.

In Kenya, studies conducted in various regions of the country have variously estimated the prevalence of myopia to range from 1.7% among primary school pupils aged 12 to 15 years in Makueni county,7.5% among secondary school-going adolescents aged 13 to 19 years in Kakamega county, 9.4% among standard eight pupils aged 12 to 15 years attending public schools in Nairobi county and up to 15.6% among students aged 14 to 20 years attending public high schools in Nairobi county (Muma *et al.,* 2009; Nyamai *et al.,* 2016; Nzuk *et al.,* 2006; Ragot *et al.,* 2020). Prevalence of myopia in Kenya is drastically increasing because of digitalization. With proliferation of digital devices, teenagers in Kenya, like in many countries are spending more time indoors and engaging in close-up activities such as reading on computers, using smartphones and playing video games. This prolonged screen time can strain the eyes and increase myopia development (Lanca and Saw, 2020).

Myopia control strategies that are used in controlling and managing myopia range from the use of multifocal contact lenses (CLs), single vision (SV) spectacles,

executive bifocal (BF), progressive addition lenses and peripheral defocus spectacles. Other strategies that help in controlling myopia are; the use of low-dose atropine 0.01% to 0.05%, medium-dose atropine 0.1% to 0.25%, high-dose atropine 0.5% to 1% (not today), multi-segmented spectacles up to combination treatment (Conrad *et al.,* 2018). The use of atropine is reported to be the most effective strategy (Coroneo *et al.,* 2018). Whereas, the use of SV spectacles is reported to be the least effective strategy, with little or no significant effect in the control of myopia progression. Therefore, there is a need to emphasize effective myopia control strategies among teenagers so as to curb visual threatening conditions that arise from myopia progression.

Regarding myopia control strategy preferences, the literature reports that choices of uptake depend widely on various influences that range from determining factors, public misconception about myopia and myopia control strategies, myopia management practices up to public health interventions (Ang *et al.,* 2020). Various influencing factors have been reported to determine the uptake of myopia control strategies including cost-related concerns, patient and parent preferences, the effectiveness of the strategy, the patient's risk of fast progression of myopia, practitioner's knowledge and skill in the control of myopia, patient suitability and availability of the strategy (Russo *et al.,* 2022).

The influence of parental awareness, resistance to wearing spectacles, eye care practitioners and parents' education, free eye camps for screening and donation of myopia control strategies have also contributed much to the uptake of myopia control strategies (Ang *et al.,* 2020). Therefore, the need to assess knowledge, attitude and factors influencing the uptake of myopia control strategy among teenagers and eye care practitioners (ECP) from a Kenyan perspective towards ensuring effective myopia management in children was exigent.

1.2 Problem statement

The growing prevalence of myopia worldwide has become a public health concern. As at 2020, myopia was shown to have affected 2.6 billion people globally and approximately half of the worldwide population will have myopia by the year 2050. Moreover, myopia is predicted to be the major cause of blindness around the world if unmanaged. Amongst African children aged younger than 18 years of age, myopia was reported at 4.75% (Ovenseri-Ogbomo *et al.,* 2022), while in Kenya among secondary school-going adolescents aged 13 to 19 in Lurambi Constituency, prevalence of myopia was approximated at 7.5% in 2020 (Ragot *et al.,* 2020). In spite of the increasing prevalence of myopia, knowledge, attitude and factors influencing uptake of effective myopia control strategies are still unknown in a Kenyan context.

Various myopia control strategies have been reported with the use of high-dose atropine (0.5% to 1%) having high efficacy whilst the use of traditional SV spectacles which has low to zero efficacy in the control of myopia progression (Coroneo *et al.,* 2018; Yan *et al.,* 2020). Despite other available effective myopia control strategies, recent studies found that most children with progressive myopia are still fitted with single vision (SV) spectacle lenses (Flitcroft *et al*., 2020; Michaud, 2020). Thus predisposing children to vision-threatening conditions, potentially leaving them visually impaired (Sankaridurg *et al.,* 2021; Spillmann, 2020). Implementing effective myopia control strategies would reduce the natural control of myopia and thereby decrease the burden of visual impairment (Michaud, 2020). Therefore, this research was conducted to establish the possible knowledge, attitude and factors influencing the uptake of myopia control strategies among teenagers and ECPs of Lurambi Constituency, Kenya.

1.3 Objectives of the Study

1.3.1 Broad Objective

To assess the knowledge, attitude factors influencing the uptake of myopia control

strategies among teenagers and ECPs of Lurambi constituency, in Kakamega County of Kenya.

1.3.2 Specific Objectives

i. To determine the uptake of myopia control strategies among teenagers and uptake of effective myopia control strategies among ECPs of Lurambi constituency.
ii. To evaluate the knowledge on various myopia control strategies among teenagers and ECPs of Lurambi Constituency.
iii. To evaluate the attitude on various myopia control strategies among teenagers and ECPs of Lurambi Constituency.
iv. To investigate factors influencing the uptake of myopia control strategies among teenagers and ECPs of Lurambi Constituency.
v. To determine the association between the identified influencing factors and uptake of various myopia control strategies among teenagers and ECPs of Lurambi Constituency.

1.4 Research Questions

i. What is the uptake of myopia control strategies among teenagers and uptake of effective myopia control strategies among ECPs of Lurambi Constituency?
ii. What is the knowledge on various myopia control strategies among teenagers and ECPs of Lurambi constituency?
iii. What is the attitude on various myopia control strategies among teenagers and ECPs of Lurambi constituency?
iv. What are the factors influencing the uptake of myopia control strategies among teenagers and ECPs of Lurambi constituency?
v. What is the association between the identified influencing factors and the uptake of various myopia control strategies among teenagers and ECPs of

Lurambi constituency?

1.5 Research Hypothesis (NULL)

(H_0): There is no significant association between the identified influencing factors and the uptake of various myopia control strategies among teenagers and eyecare practitioners in Lurambi Constituency.

1.6 Justification of the Study

Myopia is the most prevalent refractive error (R.E) and it has been reported to mostly affect teenagers (Blanco et al., 2020; WHO et al., 2018). Lurambi constituency is one of the constituencies in Kenya having the highest number of teenagers and also, it recorded a high prevalence of myopia among teenagers to be 7.5% (KNBS, 2019; Ragot et al., 2020), yet there is no evidence of any study on knowledge, attitude and factors influencing the uptake of various myopia control strategies. Wolffsohn et al. (Wolffsohn et al., 2020) showed that myopia is on the increase in teenagers, in light of the exposure to long reading hours and limited outdoor activities (Tshivhase et al., 2022), teenagers may be at high risk of myopia onset and progression. Moreover, since myopia tends to stabilize around the age of 21 (Bullimore et al., 2023), studying teenagers is particularly important. These gaps demonstrated the need for the study to ascertain knowledge, attitude and factors influencing the uptake of myopia control strategies among teenagers and ECPs of Lurambi Constituency.

1.7 Significance

The findings of this study are anticipated to provide relevant information to increase awareness among stakeholders, optometrists, clinicians, parents, teachers, and policymakers on strategies for addressing myopia. These findings are expected to form the basis for policy formulation regarding myopia control by the Ministry of Health's Ophthalmic Unit. This will help prevent avoidable blindness caused by myopia (WHO et al., 2018). Additionally, it aims to improve the quality of care for

children with myopia and, by extension, enhance the academic performance of school-aged children with myopia in Kenya.

1.8 Scope of the Study

The study focused on assessing knowledge, attitude and factors influencing the uptake of myopia control strategies among teenagers and ECPs. These was selected from teenagers and ECPs of Lurambi constituency, Kakamega County. The study only targeted teenagers of 13 to 19 years and eye care practitioners (Ophthalmologists, Optometrists and Ophthalmic clinical officers) who could diagnose and manage myopia as they were perceived to have information on knowledge, attitudes and factors influencing the uptake of various myopia control strategies.

1.8.1 Limitations

Using a questionnaire instead of conducting direct observations may have introduced recall bias, as teenagers and ECPs were to give an account of their knowledge, attitudes and factors influencing the uptake of myopia control strategies. However, to mitigate the recall bias and ensure validity of the study findings, the objectives of the study were clearly defined with specific information that helped to gather accurate data and piloting of the study was done to identify any ambiguities, confusing questions or issues with recall. Also, the use of questionnaires may have led to non-response bias, response bias and question biases which was difficult to avoid. However, piloting the questionnaire which invited suggestions helped to further minimize question bias. Furthermore, SV spectacles is not a myopia control strategy rather a vision correction strategy, including it as a strategy and it should not overestimated the uptake of MCS.

1.8.1 Delimitations of the study

The study focused on assessing knowledge, attitude and factors influencing the uptake of myopia control strategies among teenagers and ECPs. These was selected from teenagers and ECPs of Lurambi constituency, Kakamega County. The study focused exclusively on teenagers aged 13 to 19 years who had myopia of ≤0.50Ds, excluding those with myopia but had other conditions like cataract. Additionally, only ECPs such as ophthalmologists, optometrists, and ophthalmic clinical officers who had have worked for a minimum of six months and could diagnose and manage myopia were included.

1.9 Theoretical and Conceptual Framework

1.9.1 Theories of Myopia Progression

As a child's body develops their eyes develop as well. At birth, most babies are hyperopic and as they grow their eyes undergo the emmetropisation process (Chigozie, 2017). At six years the process ensures that the length of the eye and the curvature of the cornea and lens are stabilized to obtain clear vision naturally (Salmon, 2014). The axial length in children is regarded as normal when it is 24mm at emmetropisation (Zhang *et al.,* 2017). It is possible for myopia can start developing as early as the age of six years and progresses until their teenage (Bullimore and Richdale, 2020). During process of emmetropisation, the eyeball elongates too much and too quickly and less commonly the cornea or lens becomes too steep leading to myopia (Rozema *et al.*, 2023). Globally, myopia has been classified into three categories; myopia of -0.25Ds to -3.00Ds to mild myopia,-3.25Ds to 6.00Ds to moderate myopia and ≥-6.00Ds to high myopia (Flitcroft *et al.,* 2019). Literature has shown that children with high myopia are at a high risk of myopia progression (Smith and Walline, 2022).

Myopia progression in children is usually axial myopia (Mak *et al.,* 2018). It occurs when the eyeball is too long, relative to the focusing power of the cornea and

crystalline lens as light rays enter the eye from a distance to focus in front of the retina causing blur (Brennan *et al.,* 2021).Children diagnosed with myopia should be given an effective strategy to prevent it from progressing (McCrann *et al.,* 2018). This is because any degree of myopia can increase a person's risk of myopia progression thus predisposing them to serious vision problems later in life (Spillmann, 2019). Studies have shown that the progression of myopia is exacerbated by several factors ranging from genetics, reduced time spent outdoors, extended periods of near work and higher level of education (Morgan *et al.,* 2021; Tedja *et al.,* 2019).

Various studies have shown that age group may suggest the rate of myopia progression. A study on myopia progression among children and teenagers aged 4 to 17years found myopia progression to be higher in the age groups of 7 to 9 years and 10 to 12 years with -0.50Ds more per year as compared to other age groups (Tricard *et al.,* 2022). Most recent evidence shows myopia progression continues into adulthood of 20 to 30 years with an average myopia progression of up to 1.00Ds per year (Bullimore *et al.,* 2023). Myopia may still progresses in adulthood up to 30 years because of individual lifestyle choices. Career choices that involve extensive near work or inadequate visual ergonomics, can contribute to the ongoing progression of myopia. Moreover, delayed myopia onset may not manifest until adulthood and once it does it can progress at a noticeable rate. This delayed onset of myopia can start abruptly and lead to rapid progression.

Myopia progression starts to stabilize between the age of 15 and 20 years with an average of 16 years (Bullimore *et al.,* 2023). Depending on the level of myopia, most myopes with low or high myopia stabilize at 20 years whereas, those with high myopia may continue to progress in their twenties (Baird *et al.,* 2020). Research also suggests the earlier the onset of myopia the longer it takes for myopia to stabilize as the axial length continues to elongate when other parts of the eye have reached maturity (Pärssinen and Kauppinen, 2019). Polling et al. estimated the age at which myopia stabilizes ranges from about 50% to have stabilized their

myopia at 15 years, about 75% at 18 years, about 90% at 21 years and nearly all people with myopia their myopia to stabilize at 24years (Polling *et al.*, 2022). There have been principled explanations for this progression which include:

1.9.1.1 Hyperopic Defocus Theory on Myopia Progression

Most newborns and very young children are typically hyperopic (Iribarren *et al.*, 2015), a condition attributed to either axial or refractive hyperopia (Zorena *et al.*, 2018). In such cases, a plus lens is required to enhance the eye's focusing power, allowing light to focus accurately on the retina. Normally, during childhood and early adolescence, the eyeball elongates as part of natural development, enabling light to focus on the retina without the need for accommodation (Dolgin, 2015). However, in myopia, the elongation of the eyeball persists beyond the emmetropisation phase, causing excessive axial growth and resulting in myopia (Rozema *et al.*, 2023).

When engaging in near work, the eye may detect peripheral images as hyperopic, meaning they appear to focus behind the retina (Wang *et al.*, 2022). This triggers a mechanism that stimulates further elongation of the eyeball to bring these peripheral images into focus on the retina (Koulieris *et al.*, 2019). Prolonged near work can exacerbate this process, leading to additional elongation of the eyeball (Morgan *et al.*, 2012). This repeated cycle of progressive elongation increases the axial length of the eye, contributing to higher levels of myopia (Wang et al., 2021).

1.9.1.2 Accommodative Lag Theory on Myopia Progression

The accommodative lag theory is based on the idea that chronic hyperopic retinal blur will force elongation to compensate for the stimulus. Schmid et al. reported that myopes have reduced accommodative response compared to emmetropes (Schmid and Strand, 2015). Thus, limited accommodative response to blur results in the accommodative lag theory. Logan et al. showed that the amount of accommodative lag increases as myopia progresses, studies have been suggested as evidence that blur drives myopia progression (Logan *et al.*, 2021). A study

showing that myopia progresses more slowly during summer when children are not in school also provides additional support for an association between retinal blur and myopia progression due to an increase in near work (Ma *et al.,* 2021). Moreover, the correction of myopia evaluation trial with progressive addition lenses (PAL) has been shown to be slow myopia progression in children with a high accommodative lag thus supporting the theory (Aller *et al.,* 2016).

1.9.1.3 Peripheral Defocus Theory on Myopia Progression

Erdinest et al. (2023) highlighted the critical role of the peripheral retina in controlling defocus, which influences the eye's growth and refractive status. Peripheral hyperopic defocus can contribute to axial myopia, whereas peripheral myopic defocus may lead to axial hyperopia (Huang *et al.,* 2022). Atchison and Rose (2016) demonstrated that myopia progression in children is associated with a shift from peripheral myopia to relative peripheral hyperopia. Furthermore, research on progressive addition lenses (PALs) for myopia management revealed that PALs induce a myopic shift in peripheral defocus, lending support to the peripheral defocus theory (Berntsen *et al.,* 2013; Nti and Bernstsen, 2019).

1.9.2 Conceptual Framework

The absence or presence of knowledge, attitude, and influencing factors such as cost- related concerns, patient and parents' preferences, the effectiveness of the strategy, patient's risk of fast progression of myopia, patient suitability to availability of the strategy and ECPs knowledge and skills, in the uptake of myopia control strategies comprised the independent variables of the study. This assumed a linear association between knowledge, attitude and influencing factors, suggesting knowledge improvement through awareness campaigns could promote good attitudes and ultimately lead to desirable positive change in the uptake of various myopia control strategies (Nishi *et al.,* 2021). Uptake of myopia control strategies constituted the dependent variable in the study, having or not having a myopia control strategy depended on having or not having knowledge, attitude and influencing factors. Figure1.1 is the conceptual framework illustrating knowledge,

attitude and factors influencing the uptake of various myopia control strategies and their associations.

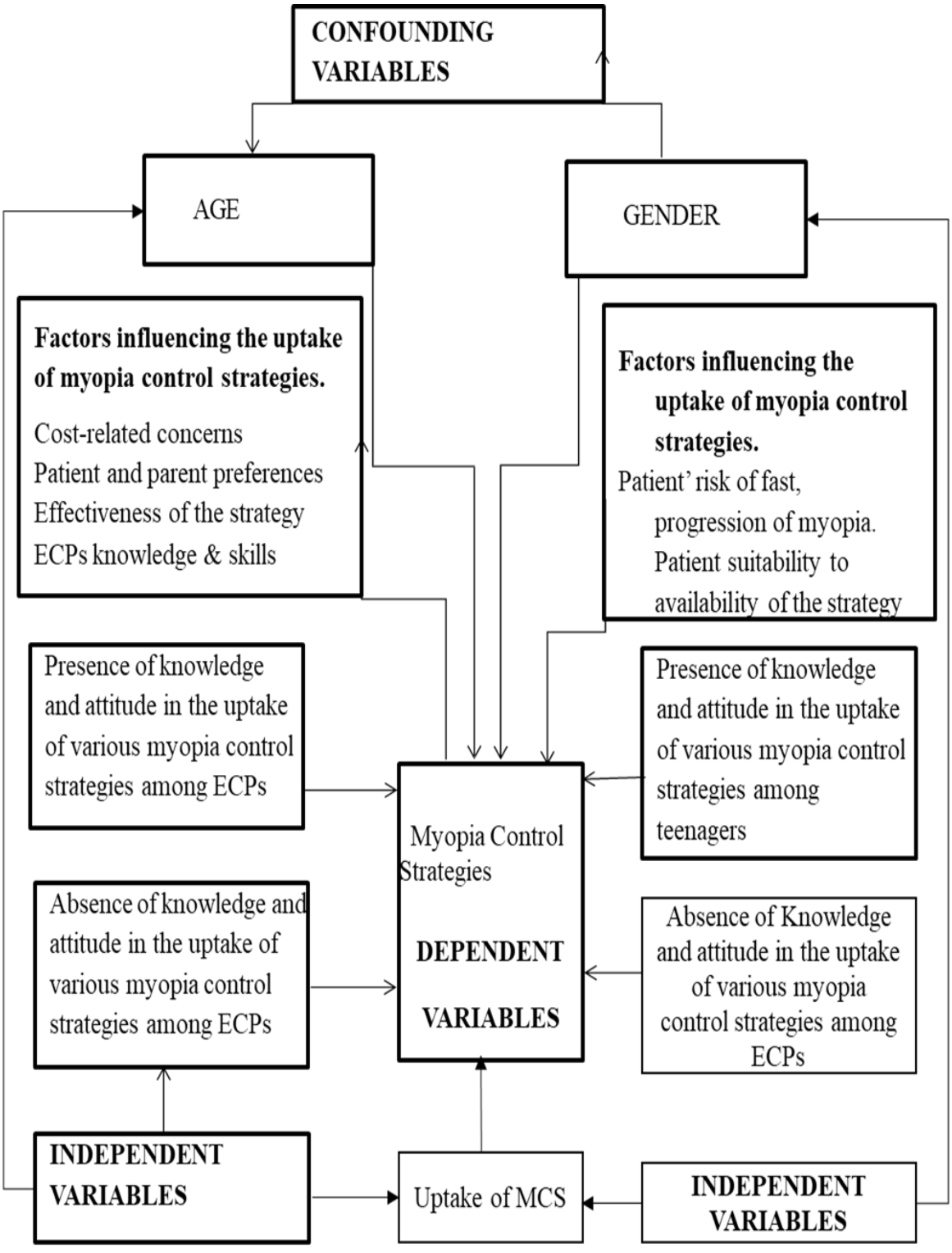

Figure 1.1 Conceptual Framework (Source: Author own creation)

CHAPTER TWO
2.0 LITERATURE REVIEW

Introduction

A review of the literature has shown the following aspects of myopia research: myopia control strategies,uptake of myopia control strategies, knowledge and attitude in the uptake of myopia control strategies from both the users and ECPs perspective, factors influencing the uptake of myopia control strategies from both the users and ECPs perspective, and the relationship between factors influencing. This led to the gap of knowledge that this study seeks to address.

2.1 Myopia Control Strategies

Myopia control is defined as the way ECPs and parents can help in reducing myopia progression in children (Modjtahedi *et al.*, 2021). Whereas myopia control strategies have been referred to as myopia management approaches that are used to stop myopia from progressing (Logan and Wolffsohn *et al.,* 2020). These strategies have been reported to be very important in managing myopia during early childhood since the earlier the child develops myopia the greater chances of its progression (Alanazi *et al.,* 2023; Ang *et al.,* 2020). Therefore, slowing myopia progression in children with an effective measure is of great importance rather than just waiting for a child's myopia from progressing (Brennan *et al.,* 2021).

Different myopia control strategies available for control of myopia onset and progression have been broadly classified into spectacle use, contact lens use and pharmacological use. The spectacles type includes the use of traditional single vision (SV) spectacles to correct myopia, executive bifocal (BF), progressive addition lenses and peripheral defocus spectacles to slow progression. The contact

lens modality that slows progression includes center distance customized multifocal contact lenses (CLs), Ortho-K and MiSight contact lenses. Lastly, pharmacological intervention range from the use of low-dose atropine 0.01% to 0.05%, medium-dose atropine 0.1% to 0.25% to previously used high-dose atropine 0.5% to 1% (Conrad *et al.,* 2018; Yum *et al.,* 2019). On efficacy level, the use of low to medium dose atropine has good efficacy in controlling myopia but with high dose the rebound side effects in children may have reduced its uptake (Cho *et al.,* 2022; Coroneo *et al.,* 2018). Contrary, the use of traditional SV spectacles is reported in the literature to have low efficacy, which approximately has zero effect on controlling myopia progression (Yan *et al.,* 2020). Regarding these studies, there is a need to emphasize on effective myopia control strategies among teenagers to curb vision threatening conditions that arise from myopia progression.

Studies have shown that age group has a role in the efficacy of various myopia control strategies as well as a reduction in myopia progression (Wolffsohn *et al.,* 2029). Normal soft CL lenses has shown to slow myopia progression between 7 to 16 years, Misight-1-day CL between 8 to 18 years and up to multifocal CL such as visioneering technologies, Natural Vue 1-day multifocal and Cooper multifocal CL at 14 to 15 years (Chamberlain *et al.,* 2023; Walline *et al.,* 2020). Other studies have shown that Peripheral defocus Single vision (PDSV) and executive bifocal spectacles were effective for children between 8 to 13 years. Low-dose atropine (0.01%) has been effective for ages four to 15-16 years, and Ortho-k lenses in young teenagers of 12 to 14 years (Cheng *et al.,* 2014; Gifford *et al.,* 2020; Tan *et al.,* 2023). However, Ortho-K lenses and low-dose atropine of 0.01% have also been recommended to be effective for children above 16 years (Gonzalez-mejome *et al.,* 2015). These studies also focus on adolescents as they have higher near-work demand in high school and enjoy e-devices in the 21st century.

Table 2.1 shows the efficacy of current myopia control strategies. Multifocal CL is reported to control myopia to within a range of 25-72% (Aller, 2014) while ortho-

K CL was recently reported to slow down myopia progression by 44% (Vincent *et al.,* 2021). Studies have reported executive bifocals to control myopia with a 50% reduction, progressive addition lenses, 11 to 33% reduction and peripheral defocus spectacles with only a 10% reduction (Cho et al, 2019; Pepose *et al.,* 2009; Wildsoet *et al.,* 2019). Low- dose atropine (0.01-0.05%) has been reported to control myopia with up to 57% and medium-dose atropine (0.1-0.25%) up to 60% (Chen *et al.,* 2010; Marcus and wong, 2020). Multifocal spectacles lenses and the use of combination treatment involving two or more of the aforementioned control strategies were equally found to be effective resulting in myopia reduction by about 57% and 50% respectively (Pineles *et al.,* 2017).A study on the comparison of three myopia control strategies (combination treatment (traditional SV & low-dose atropine eye drops of 0.01%), Ortho-K lenses and peripheral defocus spectacles) on 150 adolescents aged eight to 15 years in China reported great effectiveness of the strategies (Du et al., 2022). Comparing three groups traditional SV& 0.01% low- dose atropine, Ortho-K lenses group, and peripheral defocus lenses for 1-year found combination treatment (traditional SV & low-dose atropine eye drops of 0.01%) and Ortho- K lenses exhibit better efficacy.

Table 2.1 Efficacy of Myopia Control Strategies

Study, year	Myopia Control Strategy	Efficacy (%)
Pepose *et al.,* 2009	Progressive addition lenses	11-33
Chen *et al.,* 2010	Medium-dose atropine (0.1-0.25%)	60
Aller *et al.,* 2014	Multifocal contact lens	25-72
Pineles *et al.,* 2017	Multi-segment spectacles lenses	57
Pineles *et al.,* 2017	Combination treatment (low-dose atropine of 0.01% and spectacles)	50
Cho *et al.,* 2019	Executive bifocal	50
Wildsoet *et al.,* 2019	Peripheral defocus spectacles	10
Marcus and Wong, 2020	Low-dose atropine (0.01-0.05%)	57
Marcus and Wong, 2020	High-dose atropine (0.5-1%)*	98
Flitcroft *et al.,* 2020	Single vision spectacles	very low control
Vincent *et al.,* 2021	Ortho-K CL	44

*: rebound effects reduces efficacy

The specific strategies for control of myopia include single vision correction, PALs and CL, pharmaceutical therapy and combination therapy as discussed as follows:

2.1.1 Peripheral Defocus Single Vision Lenses (PDSV) on Myopia Progression Control

Traditional SV spectacles as a measure of myopia control have been reported to have no significance on myopia control (Yan *et al.,* 2020). A study has shown that those children who are fitted with SV spectacles still have progression (Lam *et al.,*

2020). In low to middle-income countries, SV spectacles are preferred because of their convenience, availability and affordability (Burnett *et al.,* 2021). Kang et al. reported that the use of under-correction of SV spectacles as a method of myopia control reduces myopia progression as it reduces the accommodation lag associated with myopia development (Kang, 2018).This study was contrary to the study that was done on update and guidance on myopia management that found that the use of fully or under-corrected SV spectacles does not control myopia progression (Németh *et al.,* 2021; Wolffsohn *et al.,* 2020). These two contradicting studies leaves a question of whether SV spectacles effectively control myopia or not. The impact of single-vision (SV) spectacle lenses on myopia progression continues to be a topic of clinical investigation. A one-year study on Chinese children compared the effects of under-corrected versus fully corrected SV lenses on myopia progression and axial length elongation. The findings revealed no significant differences between the two groups (Németh *et al.,* 2021). This outcome was attributed to the under-correction approach failing to provide adequate visual clarity for distance vision. Additionally, it may have triggered behavioral changes, such as reduced outdoor activity, which is known to contribute to the advancement of myopia.

Technology lenses comprise diffusion optics that aid in elevating retinal contrast signals that are perceived to reduce myopia progression in children (Panikker *et al.,* 2022). A 12- month randomized study on control of myopia using diffusion optics spectacle lenses (CYPRESS) among children aged 6-10 years with outcome measures being spherical power equivalent and axial length found that the lenses reduced myopia progression by 74% (Rapson *et al.,* 2022). CYPRESS lenses showed a high myopia control because of its design. It has a different prescription in different zones of the lenses which encourages children to use the peripheral vision more effectively. This help to reduce the strain on the eyes that is caused by prolonged near work and by reducing eyestrain these lenses potentially slow down myopia progression.

Hoya's MyoSMART lenses are primarily available in prescriptions up to -10.00D for sphere and -4.00D for cylinder. These lenses incorporate a central optical zone, 9mm in diameter, designed to correct distance refractive error. Surrounding this is an annular zone, 33mm in diameter, with multiple focal zones providing a relative power of +3.50D (Kaymak *et al.,* 2021). A two-year double-blind randomized clinical trial involving children aged 8 to 13 years demonstrated that wearing MyoSMART lenses reduced myopia progression in terms of spherical power by 52% and slowed axial length growth by 62% compared to single-vision spectacles. Importantly, discontinuing MyoSMART lens use showed no adverse rebound effects (Lam et al., 2020). Subsequent findings from a three-year follow-up study reinforced these results, confirming the sustained efficacy of MyoSMART lenses in controlling myopia progression (Lam *et al.,* 2022).

Essilor's Stellest spectacle lenses have aspherical lenslets and the power of lenslets on each ring has been determined to hold a myopic defocus which reduces myopia progression. The Stellest lenses are available for prescription from -10.00Ds sphere and - 4.00Ds cylinders (Estandiarisahromi *et al.,* 2022). In a two-year clinical trial, it indicated that the amount of myopia progression and axial length reduced by 67% in the group who was wearing this type of lenses when compared with those who were using SV spectacles lenses (Bao *et al.*, 2022). Myopilux lenses have also been reported to slow myopia progression by reducing the strain for near vision (Bao et al., 2016). In a 3-year study amongst 469 children aged 6 and 11 years, it was found that Myopilux spectacle lenses slowed myopia progression by up to 14 % (Gwiazda *et al.*, 2004). However, literature has reported that Essilor's Stellest spectacle lenses have high effectiveness in the control of myopia with easy adaptability of only one week as compared to Myopilux spectacle lenses (Essilor, 2021).

ZEISS Myovision spectacle lenses apply a principle of peripheral defocus management by inducing a peripheral myopic defocus and are available for prescription up to -10.00Ds sphere and -6.00Dc cylinder (Amella, 2022). However, its effectiveness in reducing the rate of myopia progression has not yet been shown

(Kanda *et al.,* 2018).

Finally, only single vision contacts lenses such as the Misight (Cooper Vision) are available in form of technology lenses. This is a daily disposable soft CL that is available for a prescription from -0.25Ds to -6.00Ds (Ruiz-pomeda *et al.,* 2018). A three-year clinical evaluation of these lenses including 144 children aged 8 to 12 years showed a 59% effectiveness in slowing myopia progression (Chamberlain et al., 2019). Table 2.2. Provides a summary of the efficacy of all discussed technology lenses.

Table 2.2 Efficacy of Peripheral Defocus Single Vision on Myopia Progression

Study, year	Peripheral Defocus Single Vision	Efficacy (%)	
		Refractive error	Axial Length
Kanda *et al.,* 2018	Zeiss Myovision spectacles	Not reported	Not reported
Chamberlain *et al.,* 2019	MiSight contact lens (Cooper vision)	59	62
Lam *et al.,* 2020	MyoSMART	52	62
Rapson *et al.,* 2022	Diffusion optic Spectacle lenses (CYRESS)	74	59
Bao *et al.,* 2022	Essilor Stellest	67	64
Gwiazda *et al.,* 2004	Myopilux lenses	4	Not reported

2.1.2 Multifocal Spectacles and Contact lenses

The use of multifocal spectacles both progressive and bifocal spectacles allows the user to see the objects both at near and distance and this reduces myopia progression by reducing near accommodative demand, this is because it increased the depth of field and accommodative amplitude that reduces lag of accommodation (Carlà *et al.,* 2022). A three-year follow-up study on the use of multifocal spectacle lenses in school-aged children found them highly effective in

controlling myopia progression (Chen *et al.*, 2022). This efficacy was attributed to the plus power in the peripheral zones of the lenses, which created peripheral blur, signaling the retina to reduce myopia progression. Similarly, multifocal contact lenses with a distance-center design have demonstrated effectiveness in slowing the progression of myopia (Gong *et al.*, 2017). Research on myopia control strategies, including central and peripheral plus-powered contact lenses as well as extended depth-of-focus (EDOF) lenses, has shown significant results in managing myopia progression (Bullimore & Richdale, 2020; Sankaridurg *et al.*, 2019). However, a recent study revealed that myopia still advanced with central contact lenses of -/+1.12D, leading to changes in spherical equivalent and axial length by -0.51D and +0.27mm, respectively, over 24 months (Sankaridurg *et al.*, 2019). This outcome was attributed to the myopic defocus induced by multifocal lenses, which effectively slowed myopia progression, particularly in compliant wearers

2.1.3 Orthokeratology

The orthokeratology method of controlling myopia has also shown good efficacy in controlling myopia. Ortho-K CL has been shown to reduce myopia progression by reshaping the cornea hence eliminating central myopia (Zhao *et al.*, 2022). A study found that the orthokeratology method is more effective in controlling myopia from -0.50 to - 4.00Ds and for children of higher myopia of more than 6.00Ds was recommended to be more effective when used together with other optical corrections during the day (Wolffsohn *et al.*, 2021). Children with myopia of greater than 6 D are recommended to use orthokeratology along with other myopia control strategies t to increase myopia control outcome. Since different myopia control strategies work in different ways to slow down the progression, combining another myopia control strategy along with orthokeratology provide a more comprehensive approach to slowing myopia progression, hence giving a good outcome.

2.1.4 Pharmacological strategies

Pharmacological agent use has also contributed to decrease in myopia progression.

Use of high-dose atropine eye drops have been shown to have high myopia control, although because of its rebound effects on children use of low-dose atropine eyedrops of 0.01% to 0.05% has been highly recommended (Fu et al., 2020). A three-year clinical trial of low- concentration atropine for myopia progression found significant results on the use of 0.02%,0.25% and 0.05% atropine eye drop in children aged 4 to 14 years. Comparatively, atropine eye drops of 0.02% and 0.025% slowed myopia progression by about one-third and atropine of 0.05% by one-half as compared to children who were on the placebo treatment (Yam *et al.*, 2022). A recent randomized three-year clinical trial on efficacy and safety of 0.01% and 0.02% low-dose atropine for the treatment of pediatric myopia progression among 3 to 16 years in North America and European countries found a significant result by use of low-dose atropine of 0.01%. (Zadnik *et al.*, 2023).The study employed a double-masked placebo control and a parallel group. Five hundred and seventy-six participants with -0.50 Ds to -6.00Ds and those who had aspherical equivalent and with -1.50Ds astigmatism were enrolled in the study. Four hundred and eighty-nine participants were in the age group of 6 to 10 years. The outcome measures of the study were the proportion of participants responding to therapy with <0.50Ds for 3 years and changes in the axial length measurements. The study found low-dose atropine of 0.01% to have great efficacy and was safest to use as compared to low-dose atropine of 0.02% and placebo measure. These studies show different levels of myopia reduction since the higher the concentration of atropine eye drops the higher efficacy level on myopia control. This is because high concentration of atropine eye drops effectively inhibits the muscarinic receptor of the retina and sclera by reducing axial length. Moreover, studies have shown that higher concentration of atropine eye drops is associated with greater reductions in axial length, which is a key factor in the development of myopia. Therefore, low-dose atropine eyedrop may be used as a myopia control measure in children with myopia because of its observed safety and efficacy.

2.1.5 Combination strategies

A combination method has been the most used measure of controlling myopia because of its high effect. The combination method is where atropine eye drop is used together with ortho-K or spectacles. However, a study has shown that the use of atropine eye drops along with Ortho-K is more effective as compared to when used along with spectacles (Tan *et al.,* 2020). A study on the combined effect of low-dose atropine with orthokeratology in pediatric myopia has shown a significant myopia control by the use of low-dose atropine and ortho -K CL compared to the use of Ortho-k lenses alone (De-hita-cantalejo *et al.,* 2020). This was because orthokeratology was more effective in slowing axial elongation and it was well-accepted for treatment (Foster and Jiang, 2014). Whereas the use of low-dose atropine intervention changed the sclera thus showing promising efficacy (Holden *et al.,* 2014). Therefore, soon greater demand will be the emphasis on the use of ortho-k CL together with low-dose atropine eye drops because of their high efficacies. Another study, on optical and pharmacological strategies for myopia among children, found that the use of optical devices i.e. SV spectacles or BF spectacles or progressive lenses together with the use of pharmacological treatment (low-dose atropine) still gave a promising effect on myopia control (Kang, 2018). Therefore, the above myopia control strategies show promise in improving the efficacy of myopia control in the present and the near future.

2.1.6 Proposed (new) strategies

Repeated low-level red light (RLRL) is an emerging treatment for myopia control. The mechanism behind RLRL therapy to how it shortens the axial length and reduces myopia is still unknown (Wang *et al.,* 2023). However, RLRL therapy in its form of heat has been reported to increase choroidal blood perfusion that reduces sclera hypoxia, thus inhibiting the development of myopia (Zhou *et al.,* 2020). Various studies have shown that repeated use of low-level red light has a great significance on myopia control. A recent study on the effect of repeated low-level red-light therapy (RLRL) for myopia control in children found that

repeated low-level red-light therapy was a promising alternative treatment for myopia control in children (Jiang *et al.,* 2022).

A randomized three-year study on the myopia control effect of repeated low-level red- light therapy among Chinese children aged 7 to 12 years with the myopia of at least - 0.50Ds or less and anisometropia of 1.50Ds or less had a significance on myopia control (Dong *et.al,* 2018). The study enrolled 112 participants who were divided into two groups; one as an intervention group and another one as a control group thereafter were scheduled for 3mins per person for at least 4hrs in a day. RLRL therapy was provided to their desktop with a red-light therapy device which was to be administered at home. Cycloplegic refraction and axial length were measured as a baseline after 6 months. The study indicated that those children in the intervention group showed less myopia progression and axial length than those in the control group. Therefore, RLRL therapy may be used as a treatment option for myopia since it is well tolerated without any adverse effects.

On the effectiveness of RLRL therapy, one study that used 650nm of RLRL in the city of Shenzhen found a myopia reduction of myopia by 65% (Zhi-Hong *et al.,* 2023). Another study among school-aged children in China with pre-myopia estimated 54% of myopia reduction with RLRL therapy (He *et al.,* 2023). These studies imply that RLRL therapy plays a vital role in myopia, especially in children with severe myopia which cannot be controlled by other myopia control strategies. However, a recent study has shown that long-time use of RLRL has an ocular complication of macular degeneration in children (Cougnard-Gregoire *et al.,* 2023). This approach has now become controversial to use.

2.1.7 Uptake of Strategies

A recent study on global trends in myopia management, attitude and strategies has estimated the uptake of various myopia control strategies (Wolffsohn *et al.,* 2020). A self- administered internet-based questionnaire was distributed in eight

languages through professional bodies of ECPs globally. The study found that uptake of orthokeratology by ECPs was the most followed by pharmacological intervention and soft CL with traditional SV having the least uptake. Another study among children aged 5-18years in Ireland, reported 85% uptake of Misight CL by the users with an increase in uptake from 3% to 27% from the year 2017 to 2021 (Moore *et al.*, 2023).

Another international survey of CL fitting both soft and rigid for myopia control in children aged ≤17 years reported a 2.3% uptake (Efron *et al.*, 2020). The survey of CL fitters and non-CL fitters in 33 countries between January and March of every year for eight consecutive years (2011-2018), enrolled 535 contact lens fitters and 23,295 non- contact lens fitters. The study reported 52.1% of CL fitters and 12% of non-CL fitters promoted to uptake of CL. This study shows the effort of ECPs in promoting the uptake of myopia control strategies to the users and it also implies that eye care practitioners should emphasize more on the use of CL strategy in their practice.

A study on myopia management in daily routine has variously reported the extent of uptake of myopia control strategies. An online survey that comprised questions asking about the prevention and therapeutic management of childhood myopia in their daily routines that was distributed to European pediatric ECPs. Forty-eight (48) ECPs responded to the questionnaire of which 88% reported providing some advice on myopia control strategies to their patients and 100% emphasized on outdoor activities as a measure of myopia prevention. On uptake of myopia control strategies in Europe, 17% of ECPs gave defocus incorporated multiple segments (DIMS) glasses to their patients, 29% gave CL and 60% gave a low -dose of 0.01% to their patients (Eppenberger and Sturm, 2023).

More studies have been conducted on the uptake of spectacles as compared to

other myopia control strategies. A systematic review study that reviewed journals that were conducted in Asia, Europe, USA and Africa reported the uptake of spectacles at 40.09% among secondary school children (Dhirar *et al.*, 2020). Other studies have variously reported the uptake of spectacles to range from 34.8% among children and adults aged ≥ 40 years in India,13.3% among children and adults aged 14 to 49 years in the Northern District of Bangladesh, 45.8% among medical schools in Saudi Arabia, 12.1% among medical students in Nigeria and up to 22.2% among children aged 15 to 20 years in Eritrea (Alhibshi *et al.,* 2021; Chan *et al.,* 2013; Marmamula *et al.,* 2020; Megbelayin, 2014; Muhit *et al.,* 2018).

In Kenya, Nyamai et al. reported an uptake of spectacles measure at 7.6% among 14 to 20 year old's attending public school in Nairobi County (Nyamai et al, 2016), while Chikasirimobi et al. estimated a 1.1% uptake of contact lenses among patients (non- specified age) who were visiting Academic Vision Centre (AVC) in Kakamega (Chikasirimobi *et al.*, 2022). These two studies imply a lack of investigation on the uptake of myopia control strategies which may be concerning. Moreover, despite a high myopia prevalence at 7.5% that was reported recently (Ragot *et al.*,2020) in reference to Nyamai et al. and Chikasirimobi et al (Chikasirimobi *et al.,* 2022; Nyamai et al, 2016) to the uptake of myopia control strategies was very low in Kenya when compared to the uptake in other African countries i.e Nigeria and Eriteria (Chan *et al.,* 2013; Megbelayin, 2014). Considering this, having a high prevalence of myopia in Kenya with a paucity of literature on the uptake of myopia control strategies, may suggest unknown progression of myopia in Kenyan children and adolescents thus predisposing them to long-term consequences such as loss of education opportunities, loss of economic gain for individuals and impaired quality of life. Therefore, more studies should be conducted in Kenya to widely estimate the uptake of myopia control strategies. Table 2.3 attempt to provide a snapshot of discussed studies regarding the uptake of myopia control strategies.

Table 2.3 Uptake of Various Myopia Control Strategies

Study, year	Location	Myopia Control Strategies	Target group	Uptake of strategies (%)
Dhirar *et al.*, 2020	A systematic review:16 (Asia),2 (Europe), 3(USA) & 2 (Africa)	Traditional SV spectacles	preschoolers and school children	40.09
Efron *et al.*, 2020	International:19 from Europe, 6 from Asia, 4 from USA & 2 from Australia	Soft and rigid contact lenses	≤17 years	2.3
Efron *et al.*, 2020	International:19 from Europe, 6 from Asia, 4 from USA & 2 from Australia	Soft and rigid contact lenses	ECP	52% CL fitters, 12% non-CL fitters
Eppenberger and	Europe	DIMs, Multifocal contact lens,	ECP	— 17 — 29

Sturm, 2023		Low-dose atropine of 0.01%		— 60
Marmam ula *et al.,* 2020	India	Trad ition al SV spect acles	Users	34.8
Muhit *et al.,* 2018	North district of Bangladesh	Traditional SV Spectacles	15 to 49years	13.3
Moore *et al.,* 2023	Ireland	Misight contact lenses	5 to 18 years	85
Alhibshi *et al.,* 20219	Saudi Arabia	Traditional spectacles normal contact lenses	mean age= 22 years	45.8 4
Megbela yin *et al.,* 2014	Nigeria	Trad ition al SV spect acles	20-34 years	12.1
Chan *et al.,* 2013	Eritrea	Traditional SV spectacles	15 to 20 years	22.2
Nyamai *et al.,* 2016	Kenya	Trad ition	14-20 years	7.6

		al SV spect acles		
Chikasirimobi *et al.,* 2022	Kenya	Soft and rigid contact lenses	Users	1.1

2.2 Knowledge and Attitude of Uptake of Myopia Control Strategies

Knowledge is defined as the acquisition, retention and use of information or skills. Cognition through which knowledge is acquired is the process of internalizing and is differentiated from the experience of feelings. Knowledge is accumulated from both experience and education (Mains-Mason *et al.,* 2022). This uses the extent to which teenagers and ECPs know about myopia control strategies, and this includes local knowledge, beliefs, knowledge of myopia and myopia control strategies and the risks of myopia progression. On the other hand, attitude is defined as a psychological tendency that is expressed by evaluating a particular decision with some degree of favor or disfavor. Attitude comprises three components of cognition, affect and behavior. Cognition comprises true or false beliefs about the attitude and health education diminishes such beliefs and attitudes including individual feelings and inclination toward myopia control strategies (Ferdiana *et al.,* 2021).

2.2.1 Users

Knowledge and public awareness of myopia, and risk factors of myopia control strategies for children with myopia remain limited (Chikasirimobi *et al.,* 2022; Muma and Obonyo, 2020). Therefore, more effort is needed to publicize information about myopia control strategies to reduce the risks of myopia

progression. Studies have recommended that creating awareness campaigns with subsidized or free myopia control devices to the users had a better impact on both vision knowledge and myopia control (Shi *et al.,* 2020; Zhang *et al.,* 2021). Through this, it helped to improve knowledge of myopia control strategies by providing the right information and changing the attitude toward utility by the users.

Literature has shown that to impact knowledge on myopia control strategies to the users, parents should take the lead since they influence their children's preferences on myopia control devices (McCrann *et al.,* 2018). Duong recommended that myopic children with an interest in myopia control should be advised on the use of various types of myopia control strategies and patient education should be an essential element for myopia to create awareness among the users (Duong, 2019). Moreover, Loughman, (Loughman, 2021) also emphasized the importance of creating awareness of the cause of myopia and the benefits of the use of myopia control strategies to help more patient's uptake of myopia control strategies.

A study on knowledge, attitude and practice related to the use of glasses among students in, Nusa Tenggara Indonesia found that knowledge of the students on the cause of poor vision was very low. However, 62.8% of the students were able to identify correctly at least one cause of poor vision, 37% of them were able to correctly answer some signs of poor vision and 60% of them knew the treatment for poor vision. Also, students' attitudes towards glasses were moderately positive. Contrarily, 78.8% disagreed that glasses could worsen their vision, 60.6% disagreed that wearing glasses was uncomfortable and 60.9% disagreed that wearing glasses could restrict their activities (Ferdiana *et al.,* 2021).

Another study on knowledge, attitude and practice towards R.E amongst students in South Africa that used a validated self-administered questionnaire established that 63% of the students knew the causes of poor vision and 95% of the

participants had known about the mode of myopia control strategies that they were using. These gave an implication that the students knew the causes of poor vision despite those that had R.E but could not put on the spectacles always because of their bad attitude towards the spectacles worn (Khan *et al.*, 2022).

A recent study among university students in Oman that used a questionnaire which was distributed in the English language from (December 2017 and May 2018) to 275 participants reported a positive attitude toward myopia control strategies at 53.5%, a negative attitude at 36.5% and neutral perception at 10% (Vankudre and Noushad, 2021). Among public school students in Gondar City that administered a questionnaire to 390 participants reported good knowledge and attitude at 53.8% and 52.1% respectively with 31.3% responded that wearing spectacles damages the eyes (Assefa *et al.*, 2021). This studies imply that awareness about spectacle use enhanced good knowledge that led to positive attitude that helped in great uptake of the strategies. In Kenya, only one study has been conducted to elicit knowledge on contact lenses. Chikasirimobi et.al. reported that there was a very low knowledge on contact lenses with a mean score of 2.5 among the patients who were visiting Academic Vision Center (AVC) in Kakamega (Chikasirimobi *et al.*, 2022). Therefore, more studies should be conducted in Kenya to widely estimate the knowledge on various myopia control strategies.

2.2.2 Eye Care Practitioners (ECPs)

Eye care practitioners are the front liners in myopia control, regarding this various study have been carried out to elicit eye practitioners' attitudes, knowledge, and skills on myopia control. A study on knowledge, perspective and clinical practices of Austrian Optometrists, found that the optometrists were much aware of myopia control strategies but they were not practicing (Douglass *et al.*, 2020). Studies on eye care practitioners in Spain and Ireland also indicated that despite them being aware of myopia control strategies increased cost, inadequate information to patients, unpredictable outcomes, education and time restrictions were the barriers for them to prescribe myopia control strategies to patients with myopia (Martínez-

Pérez *et al.,* 2022; McCrann *et al.,* 2019). However, a study on Singaporean Optometrists that showed that other eye care practitioners were aware of myopia control strategies and 80% of them were prescribing myopia strategies in their practices on the patient's first visit (Yang *et al.,* 2022). It can be postulated that Singaporean Optometrists had good knowledge and attitudes because of its high prevalence of myopia as well as directed resources to dealing with it as South East Asian countries.

Furthermore, despite eye care practitioners being the key influencer for the use of myopia control interventions, more education on myopia control products and hands-on workshops on myopia and children management should be emphasized so that to impact them with new knowledge and skills (Mccrann *et al*, 2019). Another recent study has recommended ECPs should be having the current guideline information on myopia and myopia control strategies in their practices always so that to remind them to incorporate current myopia control strategies in their practices (Shahzad *et al.,* 2022). However, those myopia guidelines have not been established especially in African countries.

A study on knowledge and attitude of childhood myopia among Indian optometrists has estimated the extent of knowledge and attitude in the uptake of myopia. The study distributed an online questionnaire to 302 Indian optometrists. The study reported that awareness of myopia control strategies through Optometrists' continuing education, conferences, seminars, research articles and workshops contributed positively to them prescribing of traditional SV spectacle lenses, orthokeratology and low-dose-atropine of 0.01% to their patients (Kumar *et al.,* 2023).

A study on global trends in myopia management, attitude and strategies in the clinical practice in Asian countries, European countries and USA used a self-administered internet-based questionnaire examining awareness of increasing myopia prevalence, perceived efficacy and adoption of available strategies

reported good knowledge and attitude among optometrists across the globe. The study reported that ECPs were practicing myopia control strategies although there were still some significant differences within the continents (Wolffsohn *et al.*, 2023). This gave an implication that the differences in their practices could be because of some legal approvals that were still pending in some of the countries. Therefore, practitioners coming up with ways that will bring harmonization of optometrists' practice around the globe will greatly enhance patient loyalty and improve patients' clinical expectations on myopia management. Factors influencing Uptake of Myopia Control Strategies.

2.3 Factors influencing Uptake of Myopia Control Strategies

2.3.1 User

Preferences for the uptake of a strategy for myopia control in children with myopia are influenced by a list of factors. They include; cost-related concerns, patient and parent preferences, the effectiveness of the strategy, the patient's risk of fast progression of myopia and patient suitability to the availability of the strategy (Russo *et al.*, 2022). In addition, other factors such as patient convenience, degree of initial myopia as well as CL wear compliance have been reported to have an impact on the uptake of CL as a measure to control myopia (González-Méijome *et al.*, 2016). However, the extent at which these factors influence the uptake of myopia control strategies remain unknown.

Misconceptions about myopia control strategies have also been variously reported to affect the uptake of myopia control strategies. The misconception of resistance to wearing spectacles, a belief that wearing glasses in children with early myopia causes harm, and a myth that young children who wear spectacles their degree of myopia increases greatly hindered the uptake of myopia control strategies (Ang *et al.*, 2020; Liping *et al.*, 2010).

McCrann et al. reported barriers to treatment of myopia among school-going

children included increased cost of myopia control strategies, inadequate information to patients and unpredictable outcome of the strategy as constraints to acceptance and uptake of myopia control strategies in Ireland (Mccrann *et al.*, 2019). However, a Chinese study amongst rural students found that free eye screening and free myopia optical devices, cost and attractive styles of the optical devices reduced these barriers to uptake as the students knew the devices provided to them was correct their eye conditions (Li *et al.,* 2020). Therefore, there is a need for governments and various non-governmental organizations to variously screen myopia in the societies and to prioritize myopia management by offering free optical devices where cost is the major hindrance so that to prevent its long-term impact.

A retrospective South African study in semi-urban Soweto (2016-2017) reported factors such as conveniences at 39%, affordability at 36% and quality of the spectacles at 63% influencing uptake of spectacles (Naidoo *et al.,* 2018). In Nigeria, two studies have reported factors to the uptake of a myopia control strategy. One study determining factors affecting guardians' decision-making while purchasing spectacles for their children reported that material design and frame quality influenced guardians' decision to purchasing spectacles for their children (Chan *et al.,* 2021). The study enrolled 139 guardians whose children visited clinics with myopia of ≤0.50Ds, hyperopia ≥1.50Ds and astigmatism >0.75 Ds. Another cross-sectional study that used a semi-structured questionnaire among 1,241 secondary school students reported factors such as cost at 18.2% and ignorance of refractive error condition at 56.4% (Megbelayn, 2013). Although these two studies do not show myopia control uptake it illustrates a fundamental issue to general spectacle uptake which may magnify the dire concern of myopia progression in the African context. In Kenya, no study has been done to determine influencing factors in the uptake of various myopia control strategies, therefore suggesting a knowledge gap in a Kenyan context for the pressing global eyecare concern that is reaching pandemic status. Table 2.4 provides a summary of studies

discussed on influencing factors and barriers to the uptake of myopia control strategies and/or Spectacles.

Table 2.4 Factors to users influencing the Uptake of Myopia control strategies and/or Spectacles

Study	Location	User Barriers
McCrann *et al.*, 2019	Dublin (Ireland)	Cost Inadequate information Unpredictable outcome
Naidoo *et al.*, 2018	South Africa	Conveniences Affordability Quality of the spectacles
Chan *et al.*, 2021	Nigeria	Material design and frame quality influenced guardians'
Megbelayin, 2013	Nigeria	Cost Ignorance of refractive error
Wolffsohn*et al.*, 2016	Asia, Australia, Europe, North America and South America	Effectiveness of the strategy Inadequate information Unpredictability of the outcome
McCrann *et al.*, 2019	Europe	Acceptability Safety Rebound effect
Azuara-Blanco*et al.*, 2020	UK	Tolerability Adverse event rates Risk of myopia progression
NEJM ,2017	UK	Patient safety

Zloto *et al.*, 2018	Spain, East Asia, Middle East, India, Latin America, China and Korea	Risk of myopia progression

2.3.2 Eye Care Practitioners (ECPs)

Choices for uptake of myopia control strategies for ECPs are influenced by factors such as the practitioner's knowledge and skills (Russo *et al.*, 2022). Regarding this, World Health Organization (WHO) recommended that eye care practitioners should receive complete education and training on both theory and practical myopia care so that they are well-equipped to put their training into practice at the primary level. It also approved a resolution for myopia management by encouraging ECPs to incorporate clinical practice, mitigation and measurement of myopia so that to evade myopia control challenges (Bullimore *et al.*, 2019). Mccrann et al. attempted to elicit Optometrists' readiness for myopia, and found that education, training, finance, time restrictions and limited availability of myopia therapies were the constraints to the uptake of myopia control strategies (Mccrann *et al.*, 2020). Therefore, the need to align optometric training remains of major value. In addition, the lack of information on perception and adoption and the unavailability of some myopia control strategies in Africa also remains the major barrier to the uptake of myopia control strategies (Nti *et al.*, 2022). In India, inadequate consultation time and lack of regulatory approvals of intervention for slowing myopia progression were the major barriers to prescribing myopia control strategies to school- going children among Indian Optometrists (Kumar *et al.*, 2023). In 2019, a study on global trends update assessing myopia management reported barriers to the uptake of myopia control strategies to be cost at 20.6% and adequate information at 17.6% (Wolffsohn *et*

al., 2020). If these are not addressing user uptake will not improve this spurring the progression in myopia globally. However, the paucity of Kenya studies within its context is glaring on this issue.

2.4. Relationship Between Factors influencing the Uptake of Myopia Control Strategies and Uptake of Myopia Control Strategies

Factors influencing the uptake of myopia control strategies such as cost-related concerns, the effectiveness of the strategy, and the knowledge and skills of ECPs have a direct relationship with the uptake of myopia control strategies which are contrary to a factor of patient's risk of fast progression of myopia that is associated with uptake of myopia control strategies indirectly (Russo *et al*, 2022). For instance, a wealthy family has access to good healthcare because of the availability of resources and having a good awareness of the medical services choice (Sanogo and Yaya, 2020). However, the use of low atropine together with orthokeratology is likely to have high uptake compared to other myopia control strategies because of its high efficacy in controlling myopia progression (Connolly and Mena, 2021). Furthermore, it has been shown that ECPs with high training knowledge and skills in myopia and myopia control strategies are in a good position to incorporate the services into their practices (Wolffsohn *et al*, 2016). On the other hand, in developed countries SV spectacles as a measure of myopia control have a low uptake because of their risk of myopia progression, as shown by a lower percentage of use of SV spectacles as compared to other myopia control strategies (Connolly and Mena, 2021). Factors of patient preferences and patient suitability to availability of the strategy have no association with to uptake of myopia control strategies since the factors depend broadly on the situation that the patient is presented with (Brennan *et al.,* 2021). In Kenya, no study has been conducted to determine association between factors influencing the uptake of myopia control strategies and the uptake of myopia control strategies. Therefore, this situation presents an urgent need for a study to bridge the knowledge gap by determining the relationship between factors influencing the uptake of myopia

control strategies and actual uptake of myopia control strategy.

2.5 Gap in Knowledge

Knowledge, attitude and factors such as cost-related concerns, patient and parent preferences, the effectiveness of the strategy, the patient's risk of fast progression of myopia and patient suitability to the availability of the strategy have influence to the uptake of various myopia control (Kumar *et al.*, 2023; Russo *et al.*, 2022). However, the extent at which they influence the uptake of myopia control strategies remain unknown. Particularly in low to middle-income countries, traditional SV spectacle lenses are the most preferred method because of their convenience, availability and affordability (Burnett *et al.*, 2021). In Kenya, the uptake of soft and rigid CL was very low with high uptake of traditional SV (Chikasirimobi *et al.*, 2022). However, myopia in children using traditional SV spectacles still progresses (Lam *et al.*, 2020). This predisposes children to irreversible threatening eye conditions leaving them visually impaired. Therefore, recognizing and understanding the gaps in knowledge, attitudes and factors influencing the uptake of myopia control strategies among teenagers and ECPs within Kenyan context may help inform the control of myopia and thereby reduce prevalence.

CHAPTER THREE

3.0 MATERIALS AND METHODS

This chapter has detailed the study area, described the study design, and identified the target population, including the selection criteria. It has outlined the study variables, sampling strategy, and methods for determining the sample size. The chapter also covers the data collection process, including the instruments used and how the data was gathered. Additionally, it addressed the reliability and validity of the study, discussed the pilot study, explained the data analysis methods, and described the measures taken for quality assurance and ethical considerations.

3.1 Study area

The study was carried out in all eye clinics in Lurambi constituency in Kakamega County, Kenya. Lurambi constituency is located at a latitude of 0.2998 and a longitude of 34. 7518 respectively. It has both urban and rural schools and is known to be a cosmopolitan constituency compared to other constituencies (KNBS, 2019). Lurambi Constituency is majorly known for the economic activities of farming and trade. Lurambi constituency also recorded a high prevalence of myopia (7.5%) among secondary school-going adolescents (Ragot *et al.*, 2020). This made the area ideal for the study since myopia is more prevalent in teenagers as compared to younger age (Blanco *et al.,* 2020). Lurambi constituency is a constituency that is township-centered and thus comprises several eye clinics that are both public and private eye clinics as compared to other constituencies in Kakamega County. Lurambi Constituency also has Kakamega County Teaching and Referral Hospital (KCTRH) with the state of art equipment and facility in terms of expertise management of eye care that serves as a referral center within Kakamega County.

Lurambi Constituency has a total of 12 eye clinics, two public eye clinics and 10 private eye clinics. It is one of the most multicultural constituencies situated in the Western part of Kenya. Lurambi constituency is one of the 290 constituencies that have different cultures and is inhibited by people from various parts of the country.

3.2 Study Design.

The study adopted analytical cross-sectional design of both teenagers and ECPs. This research design was used since they explored the relationship between different variables (knowledge, attitude, influencing factors and uptake of myopia control strategies) in their natural settings as they occurred. These research designs measured the outcome of uptake of myopia control strategies at one point in time and therefore, were able to give knowledge, attitude and influencing factors of the outcome of uptake of myopia control strategies at the same time.

3.3 Target Populations.

Teenagers: All teenagers from both public and private eye clinics in Lurambi Constituency, Kakamega County formed the study population. The study's target population for teenagers in Lurambi Constituency was approximated to be 1473 (KCH, 2016). The teenagers with myopia were residing in Lurambi Constituency. This study particularly targeted teenagers aged 13-19 years with myopia since they may be at a high risk of myopia progression which is majorly attributed to long reading hours and limited outdoor activities (Wolffsohn *et al.*, 2020). Myopia among teenagers is also attributed to educational pressure since that is the transition point to their career (Kathryn and Morgan, 2013).

Eyecare Practitioners: The study was targeting approximately 30 ECPs who were working in both public and private eye clinics located in Lurambi constituency. The total number of ECPs in Lurambi Constituency was arrived at by a head count survey since it was challenging to obtain this from Lurambi Constituency health register as it only contained the total number of ECPs from

public eye clinics.

3.3.1 Inclusion Criteria.

The study included teenagers of 13 to 19 years with myopia who were residing in Lurambi Constituency and ECPs who had been employed and practicing for at least six months at the clinics in Lurambi Constituency. The study only focused on Ophthalmologists, Optometrists and Ophthalmic clinical officers, as they could diagnose and manage myopia. The magnitude of myopia in teenagers was graded using spherical equivalent (SE). The participants were termed to myopic if SE was greater or equivalent to -0.50Ds and they were also considered myopic if one or both eyes was myopic including antiametropic. Also, participants with astigmatism and myopic spherical equivalent were included in the study. Teenagers were required to give their assent to participate in the study and thereafter through their legal guardians or parents' consent was granted whereas ECPs were only to give consent to participate in the study.

3.3.2 Exclusion Criteria.

Those teenagers who had other pathologies that was presenting as myopia but not myopia was excluded from the study. For instance, conditions such as cataracts and uncontrolled diabetes, were excluded.

For eye care practitioner students who were working in internship or attachment at the clinic in Lurambi Constituency were excluded from the study. Also, teenagers or ECPs in Lurambi who did not give consent to participate in the study were excluded.

3.4 Study Variables

3.4.1 Dependent Variables

Myopia control strategies was the dependent variable. These myopia control strategies included multifocal CL, single vision (SV) spectacles, executive bifocal (BF), progressive addition lenses, peripheral defocus spectacles, low-dose atropine 0.5% to 1%, medium-dose atropine 0.1% to 0.25%, high-dose atropine

0.5% to 1%, multi- segment spectacles and combination treatment.

3.4.2 Independent Variables

Uptake, knowledge, attitude and factors influencing the uptake of myopia control strategies were independent variables. Some of the factors included; cost-related concerns, patient and parent preferences, the effectiveness of the strategy, the patient's risk of fast progression of myopia, the practitioner's knowledge and skill in the control of myopia and patient suitability to availability of the strategy.

3.5 Sampling Strategy.

3.5.1 Sampling Strategy

The study selected participants from Lurambi Constituency. A multistage sampling of teenagers and ECPs in Lurambi constituency was adopted. The multistage sampling strategy included:

3.5.1.1Stage 1: Sampling (Clinics)

The study data was collected from all eye clinics in Lurambi Constituency by purposive sampling. This was because some of the eye clinics in Lurambi Constituency were not documenting their patients hence giving unclear total number of teenagers visiting them. Also, this sampling strategy helped to accommodate participants (teenagers) from different economic levels hence providing a heterogeneous population suitable for the study. Moreover, a purposive sampling technique of two clusters were used to group eye clinics in Lurambi Constituency, one for public clinics and one for private clinics for the purposive of easing data collection process. Public eye clinics were identified as those eye clinics which were government institutions and they formed the first cluster while those eye clinics that were private entities formed the second cluster. The two clusters had a total of 12 eye clinics, two public eye clinics and 10 private eye clinics. However, the sample size of 115 teenagers and 22 ECPs were drawn

from all the eye clinics of Lurambi constituency.

3.5.1.2 Stage II: Census

At clinic level, all teenagers who were attending to eye clinics in Lurambi Constituency and all ECPs who were practicing in the eye clinics of Lurambi Constituency were enrolled in the study by census. This was because of the small sample size of teenagers and ECPs of Lurambi Constituency. Moreover, this sampling strategy ensured that the data that was collected was precise, detailed and comprehensive with complete representation thus leaving no room for sampling error. Figure 3.1 and 3.2 below shows sampling strategies for teenagers.

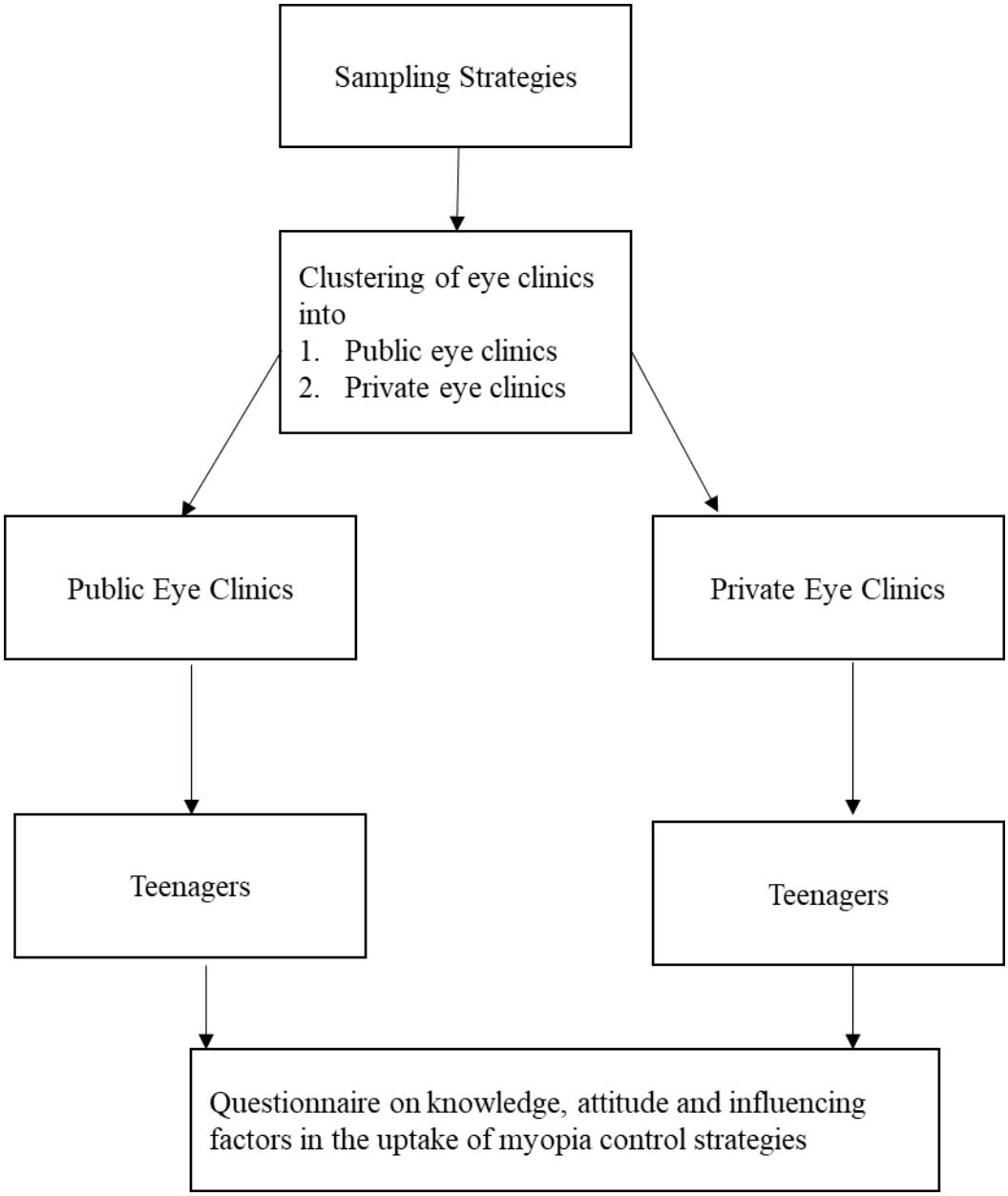

Figure 3.1 Sampling Strategies for Teenagers

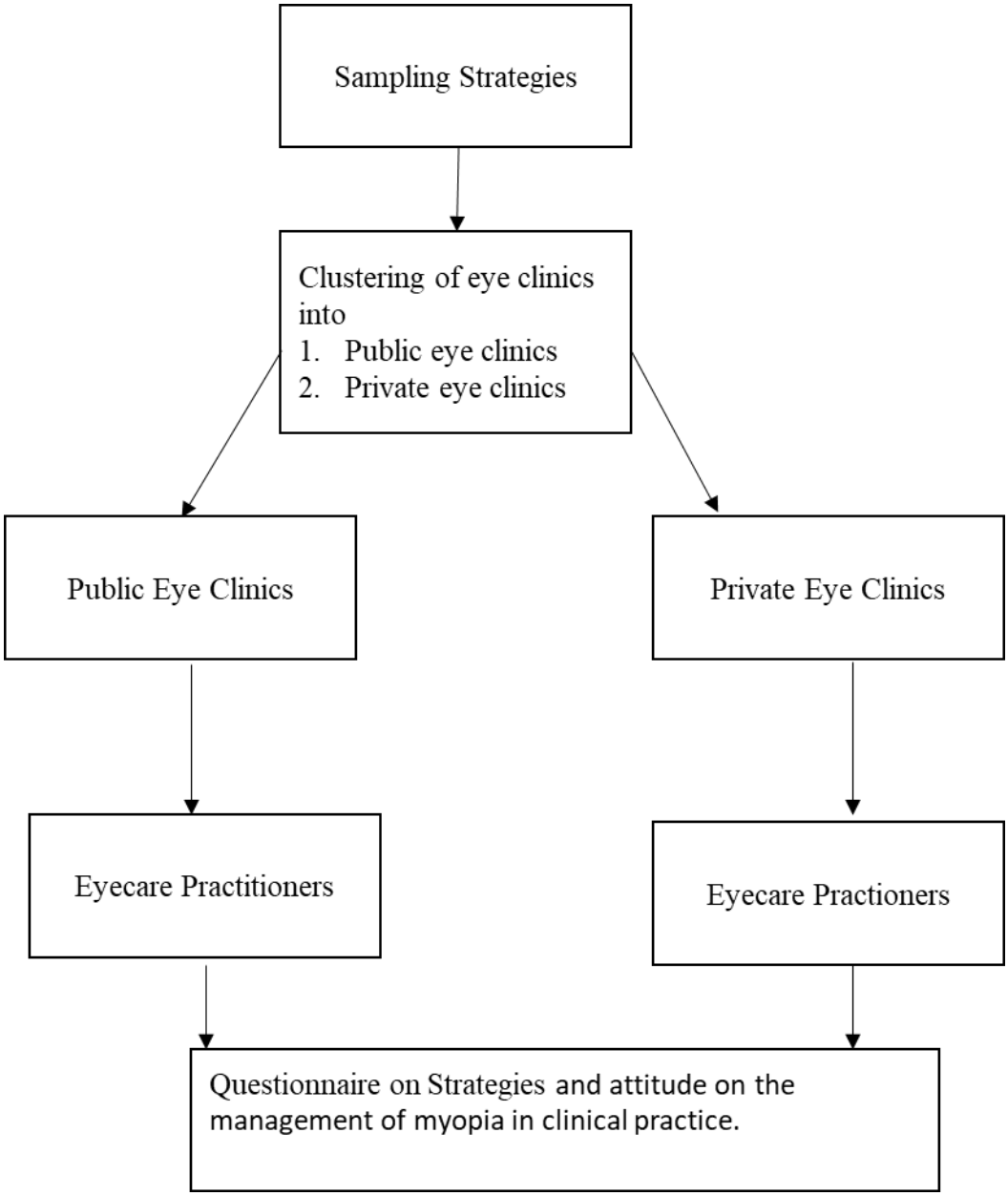

Figure 3.2: Sampling Strategies for ECPs

3.6 Sample Size Determination

3.6.1 Teenagers

Cochran WG sampling techniques was used to calculate the minimum sample size for teenagers (Wiley & Sons; 2007). The sample size determination formula that was adopted for this study n0=(Z)2*(p)(q)/(d)2 where Z is the upper point of the standard normal distribution, which is 1.96, d is a clinically acceptable margin of error, which is 5%, P is the prevalence of secondary school-going adolescents in Lurambi Constituency, which is 7.5% (Ragot *et al.,* 2020), Q=1-P, and N is the total population of teenagers in Lurambi Constituency, which was 1473 (KCK, 2016). Therefore, the sample size was 101. Taking into consideration the possibility of dropouts and unforeseen circumstances, a 10 percent (10 teenagers) non-response rate were added to the sample to make a maximum sample size of 111.

3.6.2 Eyecare practitioners

Cochran WG sampling techniques was used to calculate the minimum sample size for ECPs of Lurambi Constituency (Wiley & Sons; 2007). The sample size determination formula that was adopted for this study n0=(Z)2*(p)(q)/(d)2 where Z is the upper point ard normal distribution, which is 1.96, d is a clinically acceptable margin of error, which is 5%, P is the prevalence of secondary school-going adolescents in Lurambi Constituency, which was 7.5% (Ragot *et al.,* 2020), Q=1-P, and N is the total population of ECPs in Lurambi Constituency, which was 30. Therefore, the sample size will be 22. Taking into consideration the possibility of dropouts and unforeseen circumstances, a 10 percent (2 ECPs) non-response rate was added to the sample to make a maximum sample size of 24.

Hence, the minimum sample size for the study was 101 for teenagers with myopia and 22 for ECPs and the maximum sample size for teenagers were 111 for teenagers and 24 for ECPs

3.7 Data Collection

3.7.1 Data Collection Instruments.

A modified questionnaire on knowledge, attitude and factors influencing the uptake of myopia control strategies (Almujalli *et al.*, 2020; Ferdiana *et al.*, 2021; Kumar *et al.*, 2023; Megbelayin, 2013; Nyamai *et al.*, 2016) was used to collect data for teenagers whereas an adopted questionnaire on strategies and attitudes on the management of myopia in clinical practice in Spain (Martínez-Pérez *et al.*, 2022) was used collect data for ECPs. These questionnaires were used to achieve the objectives of the study.

3.7.2 Data Collection Procedure

3.7.2.1 Administering Questionnaire on the User (Appendix IIa)

Prior to collection of data, research assistants underwent one day training at Masinde Muliro University of Science and Technology in order to familiarize with the various data collection instruments to be used as well as the procedure involved in data collection. Permission was sought from clinic managers in which the study was to be conducted. The teenagers that were diagnosed and managed with myopia by the practicing ECPs of Lurambi Constituency at their respective clinics were required to answer a digitalized questionnaire distributed via a google form on their knowledge, attitude and factors influencing the uptake of their various myopia control strategies. Since the study was among teenagers who were minors, a written consent form was issued to the accompanying parent or legal guardian to sign. Thereafter, teenagers were asked to give assent for him or her to participate in the study. Teenagers who were diagnosed with myopia and did not have any plan with the clinic on how they should get a myopia control strategy were given a questionnaire on knowledge, attitude and factors

influencing the uptake of myopia control strategies with the help of a research assistant and those who had a plan with the clinic on how they would get a myopia control strategy, the questionnaire was administered to them on the day of correction. The questionnaire was divided in four parts. The first part was on sociodemographic distribution of the study participants consisting of participants' gender, age, type of clinic of visit and myopia power. Second part had questions revolving around knowledge on myopia control strategies. The study participants were expected to provide information on knowledge of myopia control strategy that they were using. Third part of the questionnaire entailed questions revolving around attitude in uptake of myopia control strategies. The study participants were expected to provide information on attitude of myopia control strategy that they were using. Fourth part of the questionnaire entailed questions revolving around factors in uptake of myopia control strategies. Study participants were expected to provide information on factors that influenced to the uptake of myopia control strategy that they were using. The questionnaire was in multiple choices (part 1 & part 2) and as well as a likert scale of five on i.e strongly disagree, disagree, neutral, agree and strongly agree. The study participants were required to read the questions and make choices. The questionnaire was administered in English and was piloted before administration. Figure 3.3 provides data collection protocol for teenagers.

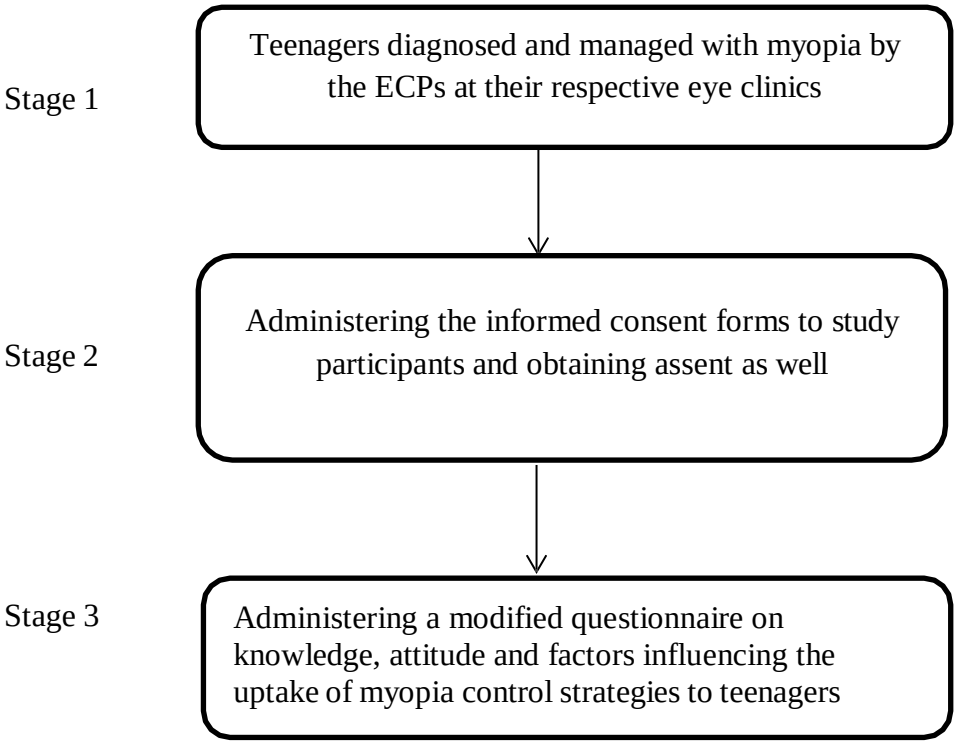

Figure 3.3 Data Collection Protocol for Teenager

3.7.2.2 Administering a Questionnaire to the Eye Care Practitioners (Appendix II)

Prior to collection of data, research assistants underwent one day training at Masinde Muliro University of Science and Technology in order to familiarize with the various data collection instruments to be used as well as the procedure involved in data collection. Permission was sought from clinic managers in which the study was conducted. At their respective eye clinics, ECPs were given a consent form to participate in the study thereafter the questionnaire on strategies and attitudes on management was given to them by the researcher for them to respond. However, those ECPs who were not at their work place with three time's consecutive visits, the questionnaire was sent to them electronically for them to respond.

The questionnaire was in multiple choices and written in English. One question on the uptake of effective myopia control strategies was amended and the rest of

the questionnaires were adopted *as used in "Strategies and Attitudes on the management of myopia in clinical practice in Spain" study.* The four-part questionnaire investigates socio demographic characteristics of ECPs, knowledge, attitude and factors on practitioners prescribing approaches on myopia control. Socio-demographic distribution of the study participants consisted of participants' gender, age, the type of eye clinic they were working at and number of experience years. Second part, third part and fourth evaluates types of various myopia control strategies prescribed to the users (teenagers), spherical power they consider prescribing various myopia control strategies to the user, which age group is appropriate in prescribing various myopia control strategies and which factors influence the uptake of myopia control strategies to their users. Figure 3.4 provides data collection protocol for ECPs.

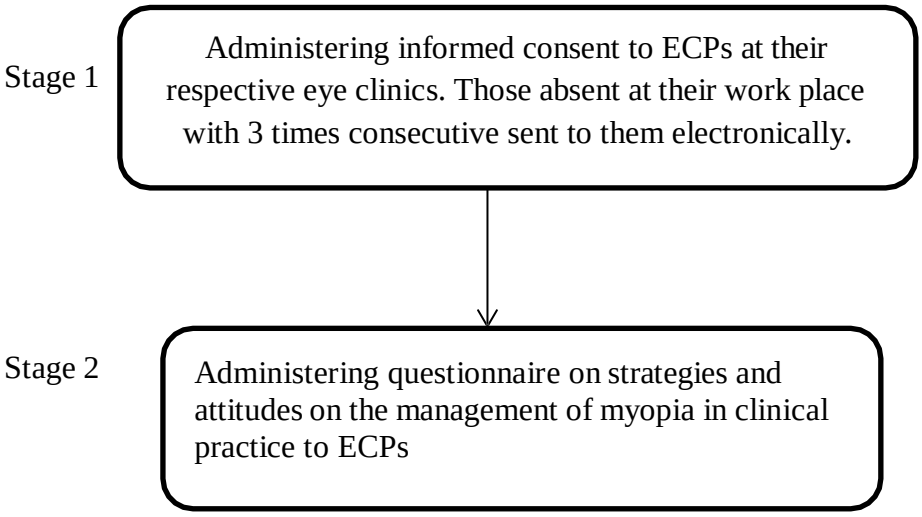

Figure 3.4 Data Collection Protocol for Eye care practitioner

3.7.3 Reliability

To achieve the reliability of the study all the study participants were subjected to the same questionnaire. After administration of both questionnaires a factor analysis was completed where applicable and the Cronbach's-alpha was used to indicate reliability. The Cronbach's-alpha for teenagers' questionnaire was found to be 0.7 indicating the acceptance level of reliability.

3.7.4 Validity

A modified questionnaire on knowledge attitude and factors influencing uptake of myopia control strategies and an adopted questionnaire on strategies and attitude on the management of myopia in clinical practice in Spain underwent validity through checks and pretesting of the questionnaire for content validity before administering it to intend respondents. Proofreading of all questions also assisted in ascertaining that the clarity, objectivity, and purpose of the study come out clearly.

3.8 Pilot Study

Questionnaires that were administered to teenagers and ECPs of Lurambi Constituency were piloted before using them for actual data collection. An adopted questionnaire on strategies and attitudes on the management of myopia in clinical practice in Spain (Martínez-Pérez *et al.,* 2022) was piloted to test whether reliability and validity of the questionnaire was still be suitable for the geographical setting of Lurambi Constituency while a modified questionnaire on knowledge, attitude and factors influencing the uptake of myopia control strategies (Almujalli *et al.,* 2020; Ferdiana *et al.,* 2021; Kumar *et al.,* 2023; Megbelayin, 2013; Nyamai *et al.,* 2016) was piloted to ascertain whether the time that was taken to fill the questionnaire and whether the responses were exhaustive. All components of the research questionnaires were checked and

coded to ensure clarity of words and the accuracy of the statements about specific research questions before actual study. This was carried out in one public eye clinic (Academic Vision Center) of Lurambi Constituency among five teenagers and three ECPs working in Private clinics in Lurambi by purposive sampling. Responses were used to improve the questionnaires before actual data collection. The respondents that participated in the pilot study were not allowed to participate in the final study. The response time was taken, and adjustments were made based on the feedback from the pre-test.

3.8 Data Analysis

Data was entered into Microsoft Excel and thereafter into Statistical Package for the Social Science (SPSS), version 27. Descriptive and inferential statistics were calculated, including the percentage and 95% confidence interval. The chi-square test was used to test the association between knowledge, attitude and identified factors influencing the uptake of myopia control strategies of the user and ECPs on various myopia control of Lurambi constituency versus the uptake of myopia control strategies. Logistic regression was used to determine the likelihood of identified factors among teenagers on various myopia control strategies among teenagers of Lurambi constituency. All the tests were two-sided, and all p-values reported was be tested at $\alpha=0.05$ level. A p-value of less than 0.05 was considered to be significant at 95% confidence interval. Odds ratio of more than 1 showed the likelihood of uptake of myopia control strategies and identified factors in myopia uptake among teenagers.

Table 3.1 Data Analyzing and Presentation.

Objectives	Variables		Statistical Tools	Data Presentation
To determine the uptake of myopia control strategies among teenagers and uptake of effective myopia control strategies among ECPs of Lurambi constituency.	Uptake of myopia control strategies		Descriptive statics (Proportions) Inferential statistics (chi-square)	Pie chart & Table
To evaluate knowledge on various myopia control strategies among teenagers and ECPs of Lurambi constituency.	Knowledge	Uptake of MCS	Descriptive statistics (Proportions) Inferential statistics (chi-square)	Table
To evaluate attitude on various myopia control strategies among teenagers and ECPs of Lurambi constituency.	Attitude	Uptake of MCS	Descriptive statistics (Proportions) Inferential statistics (chi-square)	Table
To investigate factors influencing the uptake of myopia control strategies among teenagers and ECPs of Lurambi constituency.	Factors influencing uptake of myopia control strategies. (cost, patient and parent's preference, the effectiveness of the strategy,	Uptake of MCS	Descriptive statics (Proportions	Table

	patient's suitability to availability of the strategy and ECPs Knowledge & skills			
To determine the relationship between identified factors and uptake of MCS among teenagers and ECPs of Lurambi Constituency.	Identified factors	Uptake of MCS	Inferential statistics (Logistic regression, Chi-square**)**	**Tables**

3.9 Quality Assurance and Ethical Assurance.

- Before conducting the study, ethical approval was required before carrying out the study; this was obtained from an institution of the Ethics Review Committee (IERC) of MMUST (Appendix VII) and approval from National Commission for Science, Technology and Innovation (NACOSTI) Appendix VIII to use teenagers as study participants.
- Each questionnaire was coded and each participant was identified by the number allocated to their questionnaire. The research data was only shared with supervisors with a purpose of research guidance.
- Written informed consent was obtained from the parents or guardians of all teenage participants. This ensured that the legal guardians were fully aware of the study's purpose, procedures, potential risks, and benefits before agreeing to their child's participation. (Appendix I). In addition to parental/guardian consent, informed assent was obtained from the teenagers themselves. This meant that the teenagers were provided with age-appropriate information about the study and voluntarily agreed to participate, ensuring their willingness and understanding.
- The confidentiality and anonymity of the teenage participants were strictly main-

tained. Each participant was assigned a unique code, and their personal information was protected in compliance with the Protection of Personal Information Act (POPIA). Data was anonymized for analysis and stored securely.

- Teenagers were informed that they had the right to decline from the study at any point without any negative consequences. This ensured that participation was entirely voluntary and that the participants could opt out if they felt uncomfortable at any stage. Measures were taken to prevent any form of harm, whether physical or emotional. Participants were treated with care and respect, and their privacy was protected to avoid any distress or discomfort.
- The study ensured fair and equal treatment of all participants. No participant was subjected to discrimination or bias. The selection criteria were clearly defined, and all eligible participants were given the same opportunities and protections.
- Gatekeeper Permission was obtained from clinic managers of Lurambi Constituency before carrying out the study (Appendix I).
- All data was anonymized for analysis and stored in password protected files and any hard data was stored in a locked cupboard for a period of 5 years.
- The research ensured maximum benefit to promote the welfare of the participants. Constant follow-up was done with the respective eyecare practitioners to ensure that patients with myopia are reviewed on time.
- The participants were protected from any kind of physical and emotional discomfort or harm. This was done by ensuring that the participants were treated with respect and dignity. Equality and fairness were maintained in all steps to protect subjects with emotional discomfort.
- Constant follow-up was conducted with the respective eye care practitioners to ensure timely reviews for teenagers with myopia. This ongoing support aimed to provide maximum benefit to the participants by promoting their welfare and ensuring appropriate medical care.
- Participation in the study was entirely voluntary. Participants and their guardians were fully informed about their right to withdraw from the study at any time without facing any negative repercussions.

CHAPTER FOUR

4.0 RESULTS

This results chapter provides a detailed analysis of the demographic profiles of both teenagers and ECPs. It examines the uptake of MCS among teenagers and ECPs, as well as their knowledge, attitudes, and the factors influencing the adoption of MCS. Additionally, the chapter explores the relationships between the identified factors and the uptake of MCS among both teenagers and ECPs.

4.0 Demographic Data for Teenagers and ECPs

4.0.1 Teenagers

The study sampled a total of 115 teenagers, of which 61 (53.0%) were female and 54 (47.0%) were male. Of these, 85 (73.9%) were from public clinics and 30 (26.1%) were from private clinics. The majority of participants, 50 (43.5%), were aged between 15-18 years, followed by 39 (33.9%) aged 19 years and 26 (22.6%) aged 13-14 years. Seven teenagers (6.1%) were in primary school, 15 (13.0%) in junior secondary, 57 (49.6%) in upper secondary, and 36 (31.3%) in college. Most participants, 76 (79.1%), had mild myopia of 0.50-3.00 Ds, followed by 16 (13.9%) with moderate myopia of 3.25-6.00 Ds, and 8 (7.0%) with high myopia of greater than 6.00 Ds. The mean age of the participants was 15.8 ±5.6 years, while the mean of refractive error was 0.64 ±0.29Ds. Table 4.1 shows the demographic profile of the teenager sample population.

Table 4.1: Demographic Data for Teenagers in Uptake of Myopia Control Strategies (MCS) in Lurambi Constituency, Kenya

		Total of participants n (%)	Uptake of MSC n (%)	Non-Uptake of MCs n (%)
Sample size		115	64	51
Gender	Female	61(53.0)	31(48.4)	30(58.8)
	Male	54(47.0)	33(51.6)	21(41.2)
Age	13-14 years	26(22.6)	11 (17.2)	15 (29.4)
	15-18 years	50(43.5)	26 (40.6)	24 (47.1)
	19 years	39 (33.9)	27 (42.2)	12 (23.5)
Type of eye clinic	Public	85 (73.9)	47 (73.4)	12 (23.5)
	Private	30 (26.1)	17 (26.6)	38(74.5)
School/Class grade	Primary	7 (6.1)	1 (1.6)	6(11.8)
	Junior Secondary	15(13.0)	8(12.5)	7(13.7)
	Upper Secondary	57(49.6)	33 (51.7)	24 (47.1)
	Collage	36(31.3)	22(34.3)	14(27.45)
Refractive error	0.50-3.00Ds	76 (79.1)	47 (73.5)	44 (86.3)
	3.25-6.00Ds	16 (13.9)	9(14.0)	7(13.7)
	>6.00Ds	8(7.0)	8(12.5)	0(0.0)

4.0.2 ECPs

Among them, six (27.3%) were female and 16 (72.7%) were male. Half of the ECPs, 11 (50.0%), were from public clinics, while the other half were from private clinics. The majority, nine (40.9%), were aged between 18-30 years, followed by eight (36.4%) aged 31-40 years, four (18.2%) aged 50-60 years, and one (4.5%) aged 40-50 years. Among the 22 ECPs, one (4.5%) was an ophthalmologist, four (18.2%) were optometrist doctors, seven (31.8%) were optometrists, three (13.6%) were clinical officers, and seven (31.8%) were optometry technologists. Most participants, nine (40.9%) had less than five years of experience, eight (36.4%) had 5-10 years of experience, three (13.6%) had more than 20 years of experience, and two (9.1%) had 11-20 years of experience. Table 4.2. shows the demographic profile of the ECPs sample population of 22

ECPs.

Table 4.2: Demographic Data for ECPs in the Uptake of MCS in Lurambi Constituency, Kenya

		Total participants n (%)	**Uptake of MCS n (%)**	**Non-Uptake of MCS n (%)**
Sample size		22	19	3
Gender	Female	6 (27.3)	5 (26.3)	1 (33)
	Male	16(72.7)	14(73.7)	2 (66.7)
Age	18-30 years	9 (40.9)	8 (42.1)	1 (33.3)
	31-40 years	8 (36.4)	7 (36.8)	1 (33.3)
	40-50 years	1 (4.5)	1(5.3)	0 (0)
	51-60 years	4 (18.2)	3(15.8)	1 (33.3)
	60 years & above	0 (0)	0(0)	0 (0)
Type of eye clinic	Public	11(50)	10 (52.6)	1 (33.3)
	Private	11(50)	9 (47.4)	2 (66.7)
Years of experience	Less than 5 years	9 (40.9)	8 (42.2)	1(33.3)
	5-10 years	8 (36.4)	7 (36.8)	1 (33.3)
	11-20 years	2 (9.1)	2(10.5)	0 (0)
	More than 20 years	3 (13.6)	2 (10.5)	1 (33.4)
Practicing cadre	Ophthalmologist	1 (4.5)	1 (5.3)	0 (0)
	Optometrist doctor	4 (18.2)	2 (10.5)	2 (66.7)
	Optometrist	7 (13.6)	7 (36.8)	1 (33.3)
	Ophthalmic officer	3 (13.6)	2 (10.5)	0(0.0)
	Optometrist Technologist	7 (31.8)	7 (36.8)	0 (0)

4.1 To determine the uptake of myopia control strategies among teenagers of Lurambi constituency, Kenya.

4.1.1 Teenagers

Out of the 115 teenagers who participated in the study, 64 (55.7%) adopted myopia control strategies as shown in Fig. 4.1. Table 4.3. Shows the uptake was higher among males at 33 (51.6%), those attending public clinics at 47 (73.9%), teenagers aged 19 years at 27 (42.2%), those in the upper secondary at 33 (51.7%) and those with mild myopia of 0.50-3.00 Ds at 47 (73.5%). Only a significant relationship between uptake of myopia control strategies and refractive error using the Chi-square statistic (p=0.031) was observed.

Figure 4.1 shows specific myopia control strategies and the uptake among teenagers. Of those who had uptake of MCS (n=64), single vision spectacles were at 70.3%, atropine eye drops were at 9.4%, bifocal spectacles were at 7.8%, progressive spectacles were at 4.7%, combination treatment was at 4.7% and multifocal contact lenses was at 3.0%. Ortho-K contact lenses, and multi-segment spectacles had no uptake.

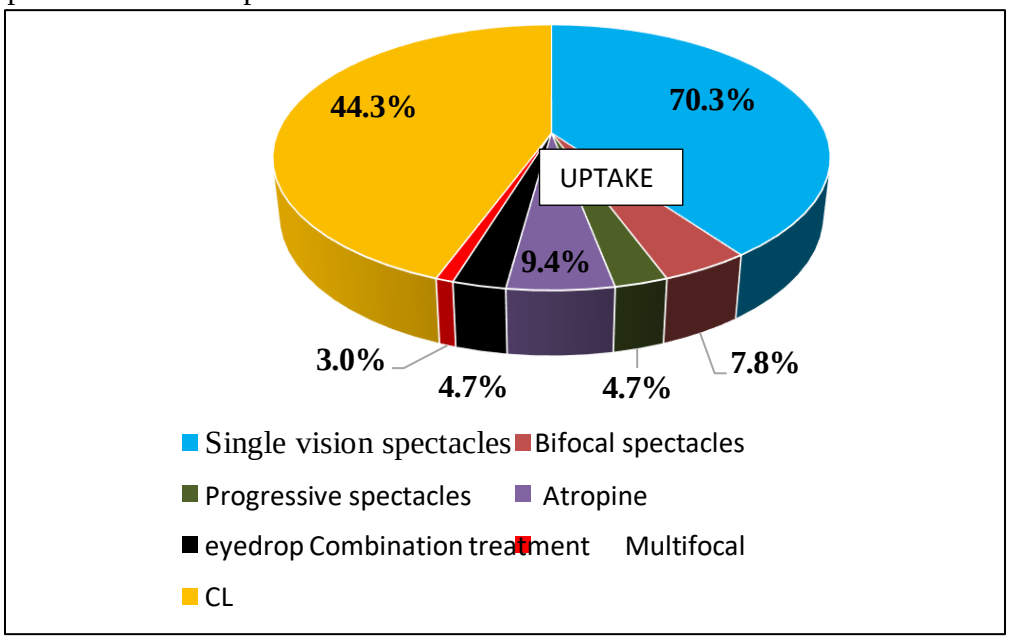

Figure 4.1 Uptake of myopia Control Strategies among Teenagers of Lurambi

Table 4.3: Demographic Profile in Relation to Uptake of MCS among Teenagers of

Lurambi Constituency, Kenya

		Total of participants n (%)	**Uptake of MSCn (%)**	**Non-Uptake of MCs n (%)**	**Chi-square P-Value**
Sample size		115	64	51	
Gender	Female	61(53.0)	31(48.4)	30(58.8)	0.105
	Male	54(47.0)	33(51.6)	21(41.2)	
Age	13-14 years	26(22.6)	11 (17.2)	15 (29.4)	0.268
	15-18 years	50(43.5)	26 (40.6)	24 (47.1)	
	19 years	39 (33.9)	27 (42.2)	12 (23.5)	
Type of eye clinic	Public	85 (73.9)	47 (73.4)	12 (23.5)	0.896
	Private	30 (26.1)	17 (26.6)	38(74.5)	
School/ Class grade	Primary	7 (6.1)	1 (1.6)	6(11.8)	0.125
	Junior Secondary	15(13.0)	8(12.5)	7(13.7)	
	Upper Secondary	57(49.6)	33 (51.7)	24 (47.1)	
	College	36(31.3)	22(34.3)	14(27.45)	
Refractive error	0.50-3.00Ds	76 (79.1)	47 (73.5)	44 (86.3)	**0.031**
	3.25-6.00Ds	16 (13.9)	9(14.0)	7(13.7)	
	>6.00Ds	8(7.0)	8(12.5)	0(0.0)	

4.1.2 ECPs

Among the 22 ECPs who participated in the study, 19 (86.36%) adopted effective myopia control strategies as shown in Fig. 4.2. Table 4.4 shows that of those with uptake, the greatest uptake was male (73.7%), those aged 18-30 years (42.2%), and those with less than 5 years of experience (40.9%) and optometry technologists at (36.8%). Uptake was equally distributed between those in private and public clinics at 50% each. A Chi-square statistic was conducted to determine relationship between demographic data and uptake of myopia control strategies

which showed no significant relationships.

Figure 4.2 shows the myopia control strategies among ECP with regards to the uptake among ECPs. Of those with uptake (n=19), single vision spectacles were at 84.2%, bifocal spectacles at 57.9%, progressive spectacles at 42.1%, low dose atropine at 21.1%, combination treatment at 15.8%, multifocal contact lenses at 10.5%, and peripheral defocus spectacles and high dose atropine were both at 5.3% each. Ortho-K contact lenses, medium dose atropine and multi-segment spectacles had no uptake (regarding the uptake of various MCS, the ECPs had the option to choose more than one strategy).

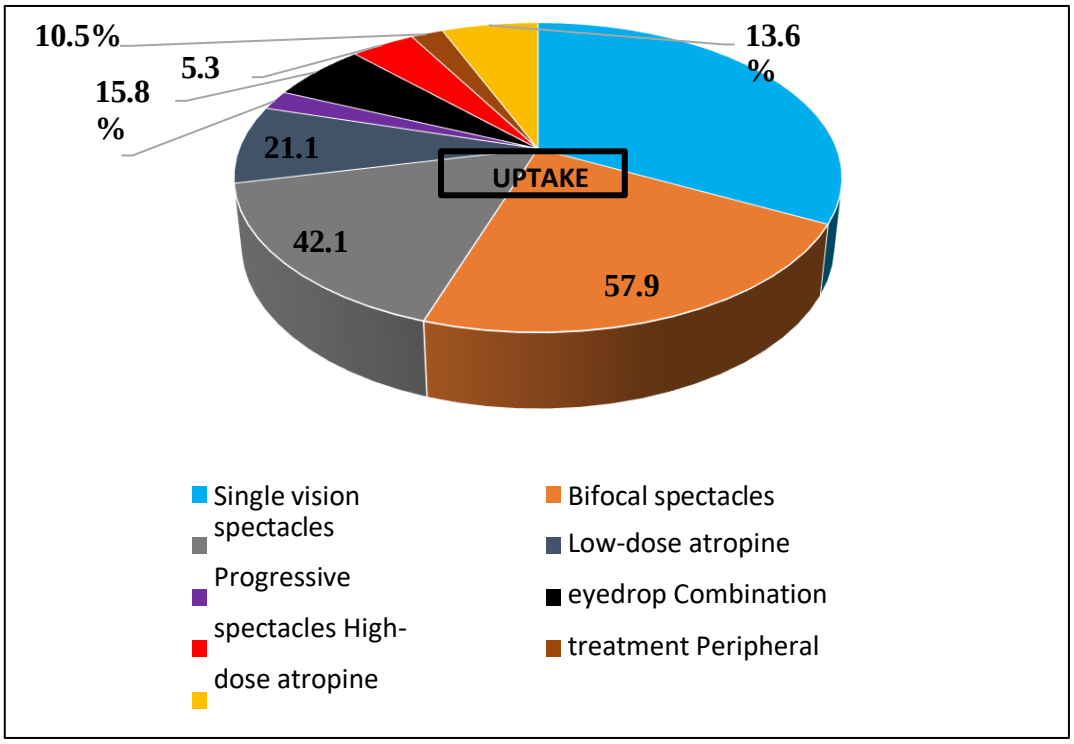

Figure 4.2 Uptake of Effective myopia Control Strategies among ECPs

Table 4.4: Demographic Profile to Uptake of Myopia Control Strategies among ECPs of Lurambi Constituency, Kenya

		Total participants n (%)	Uptake of MCS n (%)	Non-Uptake of MCS n (%)	Chi-square P-value
Sample size		22	19	3	
Gender	Female	6 (27.3)	5 (26.3)	1 (33)	0.884
	Male	16(72.7)	14(73.7)	2 (66.7)	
Age	18-30 years	9 (40.9)	8 (42.1)	1 (33.3)	0.800
	31-40 years	8 (36.4)	7 (36.8)	1 (33.3)	
	40-50 years	1 (4.5)	1(5.3)	0 (0)	
	51-60 years	4 (18.2)	3(15.8)	1 (33.3)	
	60 years & Above	0 (0)	0(0)	0 (0)	
Type of eye clinic	Public	11(50)	10 (52.6)	1 (33.3)	0.534
	Private	11(50)	9 (47.4)	2 (66.7)	
Years of experience	Less than 5 Years	9 (40.9)	8 (42.2)	1(33.3)	0.183
	5-10 years	8 (36.4)	7 (36.8)	1 (33.3)	
	11-20 years	2 (9.1)	2(10.5)	0 (0)	
	More than 20 Years	3 (13.6)	2 (10.5)	1 (33.4)	
Practicing cadre	Ophthalmologist	1 (4.5)	1 (5.3)	0 (0)	0.715
	Optometrist Doctor	4 (18.2)	2 (10.5)	2 (66.7)	
	Optometrist	7 (13.6)	7 (36.8)	1 (33.3)	
	Ophthalmic Officer	3 (13.6)	2 (10.5)	0(0.0)	
	Optometrist Technologist	7 (31.8)	7 (36.8)	0 (0)	

4.2 To evaluate knowledge in the uptake of myopia control strategies among teenagers and ECPs of Lurambi Constituency.

4.2.1 Teenagers

Knowledge Score Calculation

The knowledge score for understanding various myopia control strategies was determined through a series of questions. Participants received one point if they indicated awareness of myopia control strategies and zero points if they did not. Additional points were awarded based on recognition of specific types of strategies: one point for knowing about SV spectacles & soft and rigid CL, segmented spectacles and addition spectacles, or segmented spectacles and atropine eye drops no points were given for incorrect answers such as additional spectacles and gentamycin eye drops. For understanding the reasons behind using myopia control strategies, participants received points for correct responses: one point for knowing it slows nearsightedness from worsening and zero points for incorrect answers suh as improving vision or looking intelligent. The maximum score achievable was three points. Participants' overall knowledge was classified based on their total score: 60-100 indicated good knowledge, 40-59 indicated fair knowledge, and 0-39 indicated poor knowledge (Ogwumike *et al*., 2012).

Level of Knowledge

Regarding general knowledge in the uptake of myopia control strategies as per knowledge score. Table 4.5. Shows out of 115 teenagers, 81 (69.8%) reported having good knowledge about myopia control strategies with 31 (47.7%) having uptake of myopia control strategies. Majority of teenagers without uptake of myopia control strategies recorded a poor knowledge at 32 (62.7%). Regarding knowledge of various myopia control strategies, 58 (49.6%) teenagers knew about single vision spectacles and soft and rigid contact lenses with 40 (65.6%) having adopted myopia control strategies. Forty (34.8%) teenagers were aware

about progressive segmented spectacles and use of gentamycin eye drops. Reasons for using various myopia control strategies, 55 (47.8%) of teenagers didn't know why they were using myopia control strategies

Source of Knowledge

The major source of myopia control strategies was from eye clinician for the total sample of N=115 was at 42 (36.5%), of those with uptake 35 (50%) and of those without uptake 10 (19.6%).

Association between uptake of myopia control strategies and knowledge

There was a significant relationship between knowledge in the uptake of myopia control strategies and uptake of myopia control strategies at a significance of $p < 0.001$.

Table 4.5. Knowledge in the Uptake of Myopia Control Strategies among Teenagers

Knowledge in the Uptake of Myopia Control Strategies	Total no. of Participants n (%) (N=115)	Uptake of MCS n (%) (n=64)	Non-Uptake of MCS N (%) (n=51)
Overall knowledge on myopia control strategies as per knowledge score			
Good knowledge (>60%)	81 (69.8)	31 (47.7)	19 (37.3)
Fair knowledge	0(0.0)	25 (38.5)	0 (0.0)
Poor knowledge (<40%)	34 (30.2)	8(13.8)	32 (62.7)
Have you heard about various nearsightedness management approaches			
Yes No	83(72.2) 32(27.8)	60(93.8) 4(6.2)	23(45.1) 28(54.9)
Type of myopia control strategies you have heard			
SV spectacles and soft &rigid CL	58 (49.6)	40(65.6)	16 (31.4)
Bifocal spectacles and progressive spectacle	0(0)	0 (0.0)	0(0)
Bifocal spectacles and atropine eye drops	17(14.8)	17(26.6)	0(0)
Progressive segmented spectacles and gentamycin eye drops	40 (34.8)	7(7.8)	35(68.6)
How did you come to know about nearsightedness management approaches			
Self	12(10.4)	11(17.1)	1(2.0)
Through eye clinician	42(36.5)	32(50.0)	10(19.6)
Through the teacher	5(4.3)	4(6.3)	0(0)
Parent reference	2(1.7)	4(6.3)	0(0)

Media	6(5.2)	2(3.1)	2(3.9)
Through friends	3(2.6)	1(1.6)	2(3.9)
Through health awareness	12(10.4)	6(9.4)	6(11.8)
None of the above	33(28.7)	4(6.3)	29(56.9)
Why do you choose to use or not use approaches for managing nearsightedness			
I don't know	55 (47.8)	4 (6.1)	51 (100)
Improve vision	46 (40.0)	46 (71.9)	0(0)
Look intelligent	0(0.0)	0(0.0)	0(0.0)
Protect eyes from excessive light and injuries	7 (6.1)	7 (10.9)	0(0)
Slows nearsightedness from worsening	7 (6.1)	7 (10.9)	0(0)

4.2.2 ECPs

Knowledge Score Calculation

The knowledge score for ECPs aimed to assess their understanding of myopia control strategies. It was determined through several questions. Firstly, ECPs were asked about their awareness of myopia control strategies, with three points awarded for being very aware, two points for having some awareness, and zero points for not being aware. They were also questioned about the minimum level of myopia necessary to consider prescribing a myopia control method, with three points given for 0.50-0.75Ds, two points for 0.75-1.00Ds, and one point for >1.00Ds. Similarly, for the minimum level of myopia progression that would prompt them to adopt myopia control strategies, three points were awarded for 0.50-0.75Ds, two points for 0.75-1.00Ds, and one point for >1.00Ds per year. Lastly, ECPs were asked how frequently they follow-up with myopic children using a myopia control method, with three points for 1-3 months, two points for 4-6 months, and one point for 7-9 months. The maximum score achievable was 12 points. The knowledge score was then calculated as the total points achieved divided by the maximum points, multiplied by 100. Based on their score, ECPs' knowledge was categorized as good (60- 100 points), fair (40-59 points), or poor (0-39 points) (Ogwumike *et al.*, 2012).

Knowledge Level

Regarding knowledge in the uptake of myopia control strategies as per knowledge score. As shown in Table 4.6. All ECPs reported good knowledge at 100%. Among 22 ECPs 17 (77.3) were aware about myopia control strategies with 15 (78.9) having adopted effective myopia control strategies. Sixteen (72.7%) ECPs, recommended prescribing myopia minimum level of myopia of 0.50-0.75Ds with 14 (73.7) having adopted a myopia control strategies. Fifteen (68.1) recommended minimum level of myopia progression (diopter/year) to adopt a myopia of 0.50-

0.75Ds with 11 (57.9) having adopted effective myopia control strategies. Eleven (50.0) of all ECPs and those who had adopted effective myopia control strategies recommended a follow- up of 4-6 months.

The whole sample reported that minimum age to prescribe SV spectacles, bifocal spectacles, progressive spectacles, multifocal CL, low dose-atropine and combination treatment was between 7.5 to 8 years. High-dose atropine was thought to be prescribed at mean age of 8.7 years. Among ECPs who had adopted effective myopia control strategies. They reported minimum age that would prompt to prescribe SV spectacles, bifocal spectacles, progressive spectacles, multifocal CL and combination treatment to range from 7.7 to 8.0 years. Peripheral defocus and low-atropine were reported at 8.1 years and 8.2 years respectively and high-dose atropine at 9.2 years.

Table 4.6: Knowledge in the Uptake of Myopia Control Strategies among ECPs in Lurambi Constituency, Kenya

Knowledge in the Uptake of Myopia Control Strategies	Total no. of Participants n (%) n=22	Uptake of MCS n (%) n=19	Non-Uptake of MCS N (%) n=3
General knowledge in uptake of myopia control strategies among ECPs as per knowledge score			
Good knowledge Fair knowledge Poor knowledge	22 (100) 0 (0) 0(00	19 (100) 0(0) 0(0)	3(100) 0(0) 0(0)
Awareness of myopia control strategies			
Very aware Somehow Not aware	17(77.3) 5 (22.7) 0 (0)	15(78.9) 4(21.1) 0(0)	2(66.7) 1|(33.3) 0(0)
Minimum level of myopia that would be present to consider prescribing a myopia control method			
0.50-0.75Ds 0.75-1.00Ds >1.00Ds	16(72.7) 3(13.6) 3(13.6)	14(73.7) 3(15.8) 2(10.5)	1(33.3) 0(0) 2(66.7)
Minimum level of myopia progression (diopters/year) that would prompt you to specifically adopt a myopia control			
0.50-0.75Ds 0.75-1.00Ds >1.00Ds	15(68.1) 7(31.8) 0(0)	11(57.9) 5(26.3) 3(15.8)	1(33.3) 2(66.9) 0(0)
Frequency do you follow-up for myopic children who have adopted a myopia control method			
1-3 months 4-6 months 7-9 months 10-12 months	5(22.7) 11(50.0) 2(9.1) 4(18.2)	5(22.7) 11(50.0) 2(9.1) 4(18.2)	1(33.3) 1(33.3) 0(0) 1(33.3)
Minimum patient age (yrs) will you consider for the prescription of a myopia control method			

Single Vision Spectacles Mean age(years)	7.5	7.7	6.0
Bifocal spectacles Mean age (years)	7.7	7.9	6.3
Progressive spectacles Mean age(years)	7.7	8.0	6.3
Peripheral defocus spectacles Mean age	7.8	8.1	6.0
Multifocal CL Mean age(years)	7.7	8.0	6.0
Combination treatment Mean age (years)	7.0	8.0	6.0
Low-dose atropine Mean age (years)	7.9	8.2	6.0
High-dose atropine Mean age(years)	8.7	9.2	9.2

4.3 Attitude in the Uptake of Myopia Control Strategies among teenagers and ECPs in Lurambi Constituency, Kenya

4.3.1 Teenagers

Attitude Score Calculation

Responses to questions about attitudes towards myopia control strategies were scored as follows: Strongly agree earned four points, agree received three points, neutral is awarded two points, disagree got one point, and strongly disagree scored 0 points. There were of a total of 11 questions, each contributing a maximum of four points, totaling 44 maximum points across all questions. The general attitude score was calculated by dividing the total points achieved by the maximum points possible and multiplying by 100. Scores falling between 60-100 indicated a good attitude, 40-59 suggested a fair attitude, and 0-39 reflected a poor attitude towards managing myopia (Ogwumike *et al.*, 2012).

Attitudes

As shown in Table 4.7, the general attitude of the entire sample had a good attitude at 48.3% whilst 42.2% had an attitude that was regarded as fair as per the attitude score. Those teenagers who had adopted myopia control strategies had a positive attitude at 95.4%. Regarding comfort and self-perception, 67.6% of teenagers did not feel embarrassed about wearing optical devices for myopia correction whilst 67.0% believed that using myopia control strategies would not worsen their vision. Furthermore, 61.0% felt that using myopia control strategies did not restrict them from engaging in near activities whilst 68.7% believed that myopia control strategies were important for young people, and 63.5% thought that those who wore optical devices for myopia control took good care of their eyes. Lastly, 51.3% believed that myopia control strategies should be used regularly.

Majority, 86.9%, reported a positive attitude towards informing their parents if they experienced eye problems and 74.8% believed that myopia control strategies

were important. When regards to the appearance and optical device use, 45.2% had a neutral attitude, thinking that these individuals did not look smart, while 39.1% had a negative disagreeing that such individuals looked unattractive. Furthermore, 47.8% expressed a positive attitude, stating that myopia control strategies did not affect someone's attractiveness.

Attitude associations with uptake of myopia control strategies

The Chi-square was used to determine association between attitudes and the uptake of myopia control strategies teenagers. No association between teenagers' general attitudes and the uptake of myopia control strategies ($p=0.127$) was observed. However, a significant relationship with uptake of myopia control strategies and were found only teenagers who wore optical devices for myopia control strategies with $p=0.033$ and felt they did not appear ugly as well as those who felt their vision would not to worsen while doing near activities using a myopia control strategy with $p=0.034$.

Table 4.7: Attitudes of Teenagers in the Uptake of Myopia Control Strategies in Lurambi Constituency, Kenya

Attitude in Uptake of myopia control strategies	Total number of participants' n (%)	Uptake of MCS n (%) N= 64	Non-Uptake of MCS n(%) N=51
General attitude in uptake of myopia control strategies as per attitude			
Good attitude	56 (48.3)	62 (95.4)	25 (49.0)
Fair attitude	49 (42.2)	0 (0)	24 (47.1)
Poor attitude	10 (9.5)	2 (4.6)	2 (3.9)
When I have an eye problem, I will tell my parents			
Good Attitude	100(86.9)	57(89.1)	57(89.1)
Fair Attitude	8(7.0)	3(4.7)	3(4.7)
Poor attitude	7(6.1)	4(6.2)	4(6.2)
I think nearsightedness management approaches are very important			
Good Attitude	86(74.8)	45(70.3)	45(88.2)
Fair Attitude	5(4.3)	16(25)	3(5.9)
Poor attitude	9(7.8)	3(4.7)	3(5.9)
People who wear optical devices for nearsightedness control do not look smart			
Good Attitude	32(27.8)	15(23.4)	17(33.3)
Fair Attitude	52(45.2)	31(48.4)	21(41.2)
Poor attitude	31(27.0)	18(28.1)	13(25.5)
People who wear optical devices for nearsightedness control do not look ugly			
Good attitude	32(27.9)	28(43.8)	19(37.2)
Fair attitude	38(33.0)	21(32.8)	19(37.3)
Poor attitude	45(39.1)	15(23.4)	13(25.5)
Optical devices for control of nearsightedness do not make someone look handsome/beautiful			
Good attitude	55(47.8)	19(29.7)	29(56.9)
Fair attitude	31(27.0)	19(29.7)	10(19.6)
Poor attitude	29(25.2)	26(40.6)	12(23.5)
I don't feel embarrassed when I wear an optical device for nearsightedness correction			
Good attitude	25(21.7)	13(20.3)	14(27.5)
Fair attitude	18(15.7)	9(14.1)	7(13.7)
Poor attitude	72(62.6)	42(65.6)	30(58.8)

I feel my vision will not worsen when I use any nearsightedness management approach			
Good attitude Fair attitude Poor attitude	25(21.7) 13(11.3) 77(67.0)	12(18.8) 5(7.8) 47(73.4)	12(23.6) 9(17.6) 30(58.8)
I feel using any nearsightedness management approach does not restrict me from doing activities			
Good attitude Fair attitude Poor attitude	70(61.0) 14(12.0) 31(27.0)	45(70.3) 4(6.3) 15(23.4	34(66.7) 8(15.7) 9(17.6)
I feel young people should use any nearsightedness management approach to correct their vision			
Good attitude Fair attitude Poor attitude	79 (68.7) 12(10.4) 24(20.9)	40(62.5) 6(9.4) 18(28.1)	29(56.8) 11(21.6) 11(21.6)
I feel people who use nearsightedness management approaches take care of their eyes as well			
Good attitude Fair attitude Poor attitude	73(63.5) 15(13.0) 27(23.5)	45(70.3) 4(6.3) 15(13.0)	34(66.7) 8(15.7) 9(17.6)
I feel those who use nearsightedness management approaches must use them regularly			
Good attitude Fair attitude Poor attitude	59(51.3) 27(23.5) 29(25.2)	33(51.6) 14(21.8) 17(26.6)	23(45.1) 16(31.4) 12(23.5)

4.3.2 ECPs

Attitude Score Calculation

In assessing attitudes towards managing pediatric myopia in clinical practice, several key questions were considered for scoring: Question eight rated concern about the rise in pediatric myopia, with 'very often' earning three points, 'ocassionally' two points, and 'not important' zero points. Question nine evaluated clinical activity in myopia control, with 'very often' garnering three points, 'ocassionally' two points, and 'not important' zero points. Question 10 examined the frequency of single-vision under-correction as a strategy, scoring 'never' three points, 'sometimes' two points, and 'always' zero points.

Question11 explored changes in patient loyalty, practice revenue, and job satisfaction due to myopia management, where 'much less' scored zero points, 'less' one point, 'no change' two points, and 'more or much more' three points. The maximum achievable score across these questions was 12 points. The resulting general attitude score, calculated by dividing the total points achieved by the maximum points and multiplying by 100, categorized attitudes as follows: 60-100 reflected a good attitude, 40-59 a fair attitude, and 0-39 a poor attitude towards managing pediatric myopia in clinical practice (Ogwumike *et al.*, 2012).

Attitudes

As shown in Table 4.8. The majority of ECPs exhibited a positive attitude, with 95.5% reporting favorably. Fourteen ECPs (63.6%) frequently expressed concerns about the rising incidence of pediatric myopia in clinical practice. Similarly, 14 (63.6%) were proactive in considering myopia control strategies in their clinical approaches. Eighteen ECPs (81.9%) indicated that they sometimes prescribed single vision under correction as a tactic to mitigate myopia progression. In contrast, 11 (50.0%) noted a significant or considerable impact on patient loyalty, practice revenue, and job satisfaction due to changes in myopia management.

Attitude association with Uptake of Myopia Control Strategies

The Chi-square was used to determine association between attitudes and the uptake of myopia control strategies. No association between the uptake of myopia control strategies and the attitudes of ECPs towards these strategies was observe ($p=0.99$)**.**

Table 4.8: Attitude in Uptake of Myopia Control Strategies for ECPs in Lurambi Constituency, Kenya

Attitude in the Uptake of Myopia Control Strategies	Total no. of participants n (% n=22	Uptake of MCS n (%) n=19	Non-Uptake of MCS n (%) n =3
General attitude in the uptake of myopia control strategies			
Good attitude	21 (95.45)	18(94.74)	2(66.7)
Fair attitude	1 (4.55)	1 (5.26)	1(33.3)
Poor attitude	0(0)	0(0)	0 (0)
Level of concern about the increase in the incidence of pediatric myopia in clinical practice			
Always	1(4.5)	1(5.3)	0(0)
Occasionally	7(31.9)	6(31.6)	1(33.3)
Very often	14(63.6)	12(63.2)	2(66.7)
Activeness ECPs consider for clinical practice in myopia control			
Always	0(0)	0(0)	0(0)
Occasionally	8(36.4)	7(36.8)	1(33.3)
Very often	14(63.6)	12(63.2)	2(66.7)
Frequency which single-vision under-correction is being prescribed as a strategy to slow the progression of myopia			
Always	3(13.6)	2(10.5)	1(33.3)
Sometimes	18(81.9)	16(84.2)	2(66.7)
Never	1(4.5)	1(5.3)	0(0)
How has managing myopia changed patient loyalty, practice revenue and job satisfaction			
More or much more	11(50.0)	4(21.0)	2(66.7)
Much less	4(18.2)	3(15.8)	0(0)
Less	4 (18.2)	9 (47.4)	1(33.3)
No change	3(13.6)	3(15.8)	0(0)

4.4 Factors influencing Uptake of Myopia Control Strategies among Teenagers and ECPs of Lurambi Constituency

4.4.1 Teenagers

Factor Score Calculation

The evaluation criteria for myopia control strategies was based on a scoring system for responses, where strongly agree was allocated four points, agree was allocated three points, neutral was allocated two points, disagree was allocated one point, and strongly disagree equaled zero points. Section four of teenagers' questionnaire comprised of eight questions on factors influencing uptake of myopia control strategies. Each question represented a factor; therefore, the maximum points for each question was four points. The factor score was calculated by the formula: Factor Score = (Total Points / Maximum Points) × 100. Theafter, a factor score ranging from 50 to 100 was considered a factor, while a score from 0 to 49 was considered non-factor (Fabrigar and Wegener, 2012).

The findings in Table 4.9. Indicate of 115 teenagers, various factors were identified as influencing the uptake of myopia control strategies. Among these participants, 78 (67.8%) were influenced by the availability of myopia control strategies, 67 (58.3%) by the suitability of these strategies, 84 (73.0%) by the cost, 92 (80.0%) by eye doctor preference, and 82 (71.3%) by the effectiveness of the strategy. However, parent preference, risk of myopia progression, and patient preference did not impact the uptake. Among those who adopted myopia control strategies, 42 (65.6%) considered them available, 43 (67.2%) found the strategies suitable, 51(79.7%) were influenced by cost, 48 (75.0%) by eye doctor preference, and 48 (75.0%) by effectiveness.

4.9. Factors influencing Uptake of Myopia Control Strategies among Teenagers in Lurambi Constituency, Kenya

Factors influencing Uptake of Myopia Control Strategies	Total number of participant n (%) n =115	Uptake of MSC n (%) n =64	Non-Uptake of MCS n (%) n=51
Availability of myopia control strategies			
Factor	78 (67.8)	42 (65.6)	36 (70.6)
Non-factor	37 (32.2)	22 (34.4)	15 (29.4)
Suitability of the strategies			
Factor	67 (58.3)	43 (67.2)	24 (47.1)
Non-factor	48 (41.7)	21 (32.8)	27 (52.9)
Cost			
Factor	84 (73.0)	51 (79.7)	33 (64.7)
Non-factor	31 (27.0)	13 (20.3)	18 (35.3)
Eye doctor preference			
Factor	92 (80.0)	48 (75.0)	44 (86.3)
Non-factor	23 (20.0)	16 (25.0)	7 (13.7)
Effectiveness of the strategy			
Factor	82 (71.3)	48 (75.0)	34 (66.7)
Non-factor	33 (67.0)	16 (25.0)	17 (33.3)
Parent preference			
Factor	82 (71.3)	48 (75.0)	22 (43.1)
Non-factor	33 (28.7)	16 (25.0)	29 (56.9)
Risk of myopia progression			
Factor	47 (40.9)	40 (62.5)	28 (54.9)
Non-factor	68 (59.1)	24 (37.5)	23 (45.1)
Patient preference			
Factor	55 (47.8)	31 (48.4)	24 (47.0)
Non-factor	60 (52.2)	33 (51.6)	27 (53.0)

4.4.2 ECPS

Table 4.10 details the factors influencing the uptake of myopia control strategies among ECPs, among other factors, cost influenced the uptake of effective myopia control strategies at 54.5% and unpredictable effectiveness of strategy at 31.8%. Majority considered refractive error at 95.5%, age at 31.8% and axial length at 31.8%. Regarding criteria for the selection of first strategy to start a myopia control strategies in young myopes, age influenced at 45.5%, refractive error at

45.5% and cycloplegic refraction at 40.9%. Majority felt reasons for modifying a myopia control method or approach, were, progression of refractive error (72.7%) and progression of axial length (59.1%).

Table 4.10: Factors influencing uptake of myopia controls strategies of ECPs in Lurambi Constituency, Kenya

Identified Factor in the Uptake of Myopia Control strategies among ECPs	Total number of participants % (n) n=22	Uptake of MSC n(%) n=19	Non-Uptake N (%) n=03
Factors influencing ECPs to only fit single-vision/contact lenses to young myopes			
Unpredictable effective-ness of the strategy	7 (31.8)	7 (36.8)	0 (0)
Unpredictable effective-ness of the strategy	4 (18.2)	3 (15.9)	1 (33.3)
Cost	12 (54.5)	11 (57.9)	1 (33.3)
Additional extra time	2 (9.1)	1 (5.3)	1 (33.3)
Inadequate information	5 (22.0)	5 (26.3)	0 (0)
Knowledge benefit/risk Ratio	6 (27.3)	6 (31.6)	0 (0)22
Other factors	8 (36.4)	7 (36.8)	1 (33.3)
Criteria for the decision to adopt a myopia control strategy			
Refractive error	21 (95.5)	19 (100)	2 (66.7)
Age	15 (68.2)	12 (61.2)	3 (100)
Myopic parent (one)	7 (31.8)	6 (31.6)	1 (33.3)
Myopic parents (two)	5 (22.7)	5 (26.3)	0 (0)
Axial length	7 (31.8)	5 (26.3)	0 (0)
Choroidal thickness	3 (13.6)	2 (10.5)	1 (33.3)
Choroidal thickness re-sponsive to early treat-	1 (4.5)	1 (5.3)	0 (0)

Ment			
Binocular vision status	5 (22.7)	4 (21.1)	1 (33.3)
AC/A ratio	1 (4.5)	1 (5.3)	0 (0)
Parent preference	1 (4.5)	1 (5.3)	0 (0)
Parent/guardian ratio	3 (13.6)	3 (15.8)	1 (33.3)
Criteria for the selection of the first strategy to start myopia control in myopia control in young myope			
Availability of one method	5 (22.7)	3 (15.8)	2 (66.7)
Comfortability using /trained to use one method	0 (0)	0 (0)	0(0)
Age	10 (45.5)	10 (52.6)	0 (0)
Refractive error(non-cycloplegic)	10 (45.5)	10 (52.6)	0 (0)
Cycloplegic refraction	9 (40.9)	7 (36.8)	0 (0)
Axial length	7 (31.8)	1 (5.3)	0 (0)
Choroidal thickness	1 (4.5)	1 (5.2)	0 (0)
Binocular vision status	4 (18.2)	4 (21.1)	0 (0)
Patient preference	0 (0)	0 (0)	0(00
Other factors	1 (4.5)	0 (0)	1 (33.3)
Reasons for modifying a myopia control method/approach			
I don't know	0 (0)	0(0)	0(0)
Progression of refrac-tive error	16 (72.7)	14 (73.7)	2 (66.7)
Progression of axial Length	13 (59.1)	10 (52.6)	3 (100)
Changes in choroidal	4 (18.2)	4 (21.1)	0 (0)

Thickness			
Availability of new treatment with greater efficacy	6 (27.3)	6 (31.6)	0 (0)

4.5 Relationship between identified factors and Uptake of myopia control strategy among teenagers and ECPs of Lurambi Constituency

4.5.1Teenager

A logistic regression was conducted to determine the relationship between identified factors influencing the uptake of myopia control strategies and the actual adoption of these strategies. Only one factor showed a significant association, an increase in cost decreased the odds of uptake of myopia control strategies by 1.367.This finding suggests that cost is a significant barrier, supporting the rejection of H_0 regarding cost and uptake of myopia control strategies among teenagers, while other factors did not show significant associations, supporting H_0 for those factors. Table 4.11 shows all relationship between the identified factors and uptake of myopia control strategy among teenagers of Lurambi Constituency.

Table 4.11: Relationship between identified factors and Uptake of myopia control strategy among teenager in Lurambi Constituency, Kenya

Identified Factors influencing Uptake of Myopia Control Strategies	Odds Ratio	95% CI	P-Value
Availability of myopia control strategies	0.920	[0.686-1.235]	0.580
Suitability of myopia control strategy	1.102	[0.847-1.432]	0.470
Cost	**1.367**	[1.013-1.845]	**0.041**
Eye doctor preference	0.775	[0.571-1.053]	0104
Effectiveness of the strategy	1.250	[0.930-1.680]	0.139

4.5.2 ECPs

The Chi-square statistic was employed to evaluate the relationship between identified factors and the uptake of myopia control strategies among ECPs as shown in Table 4.12. No significant associations between these factors and the adoption of myopia control strategies. This indicates that these factors didn't have an association for adopting such strategies except refractive error and the uptake of various myopia control strategies (p=0.01), as a criteria for deciding to adopt a myopia control method for ECPs. Furthermore, the criteria for selecting the initial strategy for myopia control in a young myopes showed significant associations with binocular vision status (p=0.002) and other unspecified factors (p=0.010), leading to rejection of H_0 for these factors.

Table 4.12 Relationship between identified factors influencing the uptake of myopia control strategies among ECPs and Uptake of Myopia Control Strategies in Lurambi Constituency, Kenya

Identified Factor in the Uptake of Myopia Control strategies among ECPs	95% CI	Chi-Square P-Value
Factors influencing ECPs to only fit single-vision/contact lenses to young myopes		
I don't believe that these are any more Effective	[1.47-1.89]	0.203
Unpredictable effectiveness of the strategy	[1.64-1.99]	0.464
Cost	[1.23-1.68]	0.477
Additional extra time	[1.78-2.04]	0.116
Inadequate information	[1.58-1.96]	0.312
Knowledge benefit/risk ratio	[1.53-1.93]	0.254
Other factors	[1.42-1.85]	0.907
Criteria for the decision to adopt a myopia control strategy		
Refractive error	[0.95-1.14]	**0.010**
Age	[1.11-1.53]	0.203
Myopic parent (one)	[1.47-1.89]	0.952
Myopic parents (two)	[1.58-1.96]	0.312
Axial length	[1.47-1.89]	0.163
Choroidal thickness	[1.58-1.96]	0.285
Choroidal thickness responsive to early Treatment	[1.71-2.02]	0.644
Binocular vision status	[1.47-1.89]	0.684
AC/A ratio	[1.86-2.05]	0.637
Parent preference	[1.86-2.05]	0.684
Parent/guardian ratio	[1.71-2.02]	0.459
Criteria for the selection of the first strategy to start myopia control in myopia control in young myope		
Availability of one method	[1.58-1.96]	0.051
Age	[1.32-1.77]	0.089
Refractive error(non-cycloplegic)	[1.32-1.77]	0.089
Cycloplegic refraction	[1.37-1.81]	0.121
Axial length	[1.37-1.89]	0.203
Choroidal thickness	[1.86-2.05]	0.684

Binocular vision status	[1.53-1.93]	**0.002**
Patient preference	[1.64-1.99]	0.380
Other factors	[1.86-2.05]	**0.010**
Reasons for modifying a myopia control method/approach		
Progression of refractive error	[1.07-1.47]	0.800
Progression of axial length	[1.19-1.63]	0.121
Changes in choroidal thickness	[1.64-1.99]	0.380
Availability of new treatment with greater Efficacy	[1.53-1.93]	0.254
Poor compliance	[1.42-1.85]	0.240
Complications	[1.19-1.63]	0.774

CHAPTER FIVE

5.0 DISCUSSION

This discussion chapter has explored several critical aspects of myopia research, including the uptake of MCS among both teenagers and ECPs. It discusses the general uptake of MCS in relation to the demographic profiles of these groups. It compares the knowledge and attitudes toward MCS among teenagers and ECPs to other study populations and discusses the implications thereof. It goes on to evaluate factors that influence the adoption or lack thereof of these strategies from both the users' and ECPs' perspectives. Finally, it has analyzed the relationship between these factors influencing MCS uptake and the actual adoption of these strategies.

5.1 Uptake of Myopia Control Strategies among Teenagers and Uptake of Effective Myopia Control Strategies among ECPs of Lurambi Constituency

5.1.1 Teenagers

5.1.1.1 Demographic profile of Teenagers in Relation to Uptake of Myopia Control Strategies

Age and School/Class grade

The uptake of myopia control strategies was highest among teenagers aged 19 years compared to those aged 13-14 years and 15-18 years. This disparity can be attributed to several factors. Firstly, older teenagers, particularly those at 19 years, are at a critical stage in their education and early career paths, where clear vision is essential for academic and professional performance (Kathryn and Morgan, 2013). This heightened need for optimal vision likely drives greater awareness and adoption of myopia control measures. Additionally, as teenagers mature, their ability to understand the importance of health interventions and adhere to prescribed strategies increases, making them more likely to seek and follow

through with myopia control (WHO *et al.*, 2020). Moreover, parents and guardians may be more inclined to invest in myopia control for older teens, perceiving it as a worthwhile investment given their immediate transition into adulthood and higher education.

However, the lower uptake of myopia control strategies among younger teenagers has serious implications. Younger teens, particularly those aged 13-14, are at a critical period of myopia progression (Ducloax *et al.*, 2023). Without adequate intervention, they are at a higher risk of significant myopia advancement, which can lead to severe visual impairment and associated complications later in life (Enrique *et al.*, 2021). This lack of early intervention highlights a gap in awareness and possible accessibility to effective myopia control strategies for this age group.

Likewise, the uptake of myopia control strategies was most among teenagers in the upper secondary as compared to teenagers in primary schools, those in junior secondary school and those in collage. Teenagers in the upper secondary experience educational pressure since that is their transition point to career education life, they spent a lot of time reading so that they can perform well in their education. Prolonged reading time has been shown to increase myopia onset and progression (Bullimore et al., 2023). These explain higher uptake of myopia control strategies among teenagers in upper secondary as compared to other class/school grades.

Gender

The uptake of myopia control strategies among teenagers was higher in males. This can be attributed to behavioral factors such as boys increased likelihood to participate in virtual activities like playing video games (Scholes *et al.*, 2022). This increased screen time has been reported to be a risk factor of high myopia prevalence (Xie *et al.*, 2022). Moreover, Ragot et al., (2020) reported the high prevalence of myopia among males of 13 to 19 years of Lurambi Constituency at

52.7% and in females at 47.3%. The higher myopia prevalence in males could be translated in higher awareness which may influence uptake of myopia control strategies among teenagers of Lurambi constituency.

Type of Eye Clinics

The uptake of myopia control strategies was higher among teenagers attending public clinics compared to those visiting private eye clinics. Public clinics have advanced eye care equipment and typically offer a broader range of healthcare services, making them more accessible and frequented by the community for various health needs, including eye care (MOH,2022). This accessibility may lead to higher awareness and uptake of myopia control strategies as part of routine health visits. Additionally, public clinics often provide integrated and comprehensive care, where myopia control might be addressed alongside other health issues, increasing the likelihood of adoption (Cicinelli *et al.*, 2022). The convenience of receiving multiple health services in one location can also enhance compliance and follow-through with prescribed myopia control measures.

Refractive Error

The uptake of myopia was higher among teenagers with moderate myopia (<3Ds). This higher uptake of myopia may be attributed to socio-economic factors. Moderate myopia spectacle care has been reported to be cost-effective in its management as compared to high myopia. The dioptric power of the lenses influences the prices of spectacles and contact lenses, with higher power typically correlating with increased cost (Johnson, 2024). Therefore, justifying why majority of teenagers with mild myopia had higher uptake. However, a strategy with high efficacy is likely to be more expensive than one with lower efficacy (Agyekum *et al.,* 2023).

Teenagers with mild myopia may adopt control strategies more readily to prevent further deterioration and maintain their current quality of life (WHO et al., 2015). Conversely, those with moderate to severe myopia may already face substantial visual challenges, prompting a more urgent need for intervention.

The only significant relationship between the uptake of myopia control strategies was with refractive error. This suggests that refractive error level is a key determinant in the adoption of these strategies. This relationship can be justified by considering that individuals with different severities of myopia may experience varying degrees of impairment and thus have different motivations for seeking corrective measures (Sankaridung, 2024).

5.1.1.2 Uptake of Myopia Control Strategies

The general uptake of myopia control strategies among teenagers in this study was found to be 55.7%. Single-vision spectacles was the major MCS whilst atropine was the minor MCS. Ortho-K, multi-segment lenses was not adopted. These rates were notably higher compared to those reported by Dhirar *et al.*, (2020), who conducted a systematic review involving 16 countries from Asia, two countries from Europe, three countries from the USA, and two countries from Africa among preschoolers and school children, finding an uptake of traditional single vision (SV) spectacles at 40.09% (Dhirar *et al.*, 2020). Similarly, a study by Efron *et al.*, (2020), encompassing 19 countries from Europe, six countries from Asia, four countries from the USA, and two countries from Australian continent among children aged 17 years and younger, reported an uptake of soft and rigid contact lenses at 2.3%. It may be necessary to declare at this outset that single vision spectacles falsely skewed the uptake of MCS in the current study and it has not been shown to slow progression (Frickle *et al.*, 2019)

Muhit et al. (2018) reported an uptake of traditional SV spectacles at 13.3% among users aged 15-49 years in the North district of Bangladesh. In Saudi Arabia, Alhibishi et al. (2019) found an uptake of traditional single-vision

spectacles at 45.8% and soft contact lenses at 4% among users with a mean age of 22 years. In Africa, Megbelayin et al. (2014) found an uptake of traditional SV spectacles at 12.1% among users aged 20-34 years in Nigeria. In Eritrea, Chan et al. (2013) reported an uptake of traditional SV spectacles at 22.2% among children aged 15-20 years. Focusing on Kenya, Nyamai et al. (2016) reported an uptake of traditional SV spectacles among teenagers aged 14-20 years in Nairobi County at 7.6%. Additionally, Chikasirimobi et al. (2022) found an uptake of soft and rigid contact lenses at 1.1% among users attending the Academic Vision Center (AVC) of Kakamega, Kenya. The studies show uptake from international to continental Africa and to local Kenya.

The higher uptake of myopia control strategies in this study can be attributed to its focus on a variety of myopia control methods, unlike several other studies that primarily investigated traditional single-vision spectacles. For instance, studies (Dhirar et al. (2020), Marmula et al. (2018), Alhibish et al. (2019), Megbelayin et al. (2014), and Nyamai et al.) all concentrated on traditional single-vision spectacles, which might limit their appeal and effectiveness in myopia control. In contrast, Efron et al. (2020) and Chikasirimobi et al. (2022) explored the use of soft and rigid contact lenses, but did not incorporate a broad range of strategies. By encompassing various myopia control options, this study provides a more comprehensive approach, potentially leading to higher acceptance and utilization rates among participants.

Furthermore, the uptake of MCS in this study was higher than other studies which may be attributed to the study population age, which predominantly consisted of teenagers aged 13-19 years. Myopia is highly prevalent in this age group compared to younger children and adults (Wolffsohn et al., 2020). This may explain the increased acceptance of single- vision spectacles, which are not considered a myopia control strategy but rather a vision correction method. While many studies focus on young children in preschool to slow the progression of myopia, early intervention remains critical for teenagers as well. According to

Brennan et al. (2021), implementing myopia control strategies during adolescence can effectively slow the progression of myopia. Thus, this study's focus on teenagers, a group at high risk for myopia progression (WHO *et al.*, 2018), highlights the importance of early and continued intervention across different age groups.

Additionally, the global and local increase in the prevalence of myopia has heightened awareness and concern, driving higher uptake rates (Bullimore *et al.*, 2021). Moreover, Ragot et al. reported a high prevalence of myopia among adolescents aged 13-19 years at 7.5% of Lurambi Constituency (Ragot *et al.*, 2020). Early adoption of myopia control strategies is crucial for mitigating the progression of myopia (Ang *et al.*, 2020). While the primary focus of many studies is on young children, our study emphasizes the importance of extending these interventions to teenagers aged 13-19 years. Although this age group may not represent the earliest stage of myopia development, it remains a critical period for intervention.

Conversely, Moore *et al.*, (2023) found the uptake of Misight contact lenses among teenagers aged 5-18 years in Ireland to be 85%, significantly higher than the uptake of myopia control strategies in this study. The MiSight contact lens for myopia control is akin to other optical interventions for myopia control available to ECPs. This higher uptake in Ireland can be attributed to their focus on a single, highly effective strategy (Misight contact lenses), which is believed to control myopia progression by 59% (Chamberlain *et al.*, 2019). In contrast, this study reported a 70.3% uptake of traditional single-vision spectacles, which has a very low efficacy in controlling myopia (Flitcroft *et al.*, 2020). Additionally, the availability of optometrists capable of fitting Misight contact lenses and access to specialized local contact lens laboratories in Ireland could further explain the higher uptake compared to this study.

The findings of this indicate that while traditional single-vision spectacles are a prevalent strategy, their limited effectiveness compared to other myopia

strategies raises important considerations. The higher uptake of various myopia control methods in this study suggests that relying solely on traditional single vision spectacles may not be sufficient to address the growing myopia epidemic. This study recognizes the limitations of traditional methods and advocate for a more integrated approach, including multifocal lenses, orthokeratology, and pharmaceutical treatments. This shift in strategy is essential for achieving better long-term outcomes in myopia control and highlights the need for updated clinical guidelines that reflect the benefits of a comprehensive approach. By broadening the scope of myopia management, can cater for the diverse needs of different age groups, ultimately reducing the national burden of myopia and improving overall eye health.

5.1.2 ECPs

5.1.1.2 Demographic Profile of ECPs in Relation with their Uptake of Myopia Control Strategies

Age

The uptake of myopia control strategies among ECPs was the most among younger ECPs (18-30 years). The higher uptake of myopia control strategies among these ECPs can be attributed to several factors. Younger ECPs are likely to be more recently trained and thus more familiar with the latest advancements and recommendations in myopia management (Coverdale et al., 2024). Additionally, younger ECPs may be more adaptable and open to incorporating new techniques and technologies into their practice (Press, 2019). In contrast, older ECPs may rely more on established methods they are accustomed to and may be slower to adopt new practices due to a combination of habit, skepticism, and the comfort of familiarity. Furthermore, some may not have been trained at all and may rely on personal motivation to be trained.

Gender

The uptake of myopia control strategies among ECPs was higher among males. Gender disparities in professional opportunities and exposure to new technologies and practices might contribute to this difference. Males may have greater access to continuous professional development programs or be more represented in professional networks where myopia control strategies are discussed and promoted (Omar et al., 2024). Additionally, societal expectations and gender roles may influence professional behaviors and decision-making processes (Orlitzky et al., 2006). Males might feel more pressure to adopt innovative practices to enhance their professional standing and competitiveness in the field. Conversely, females might face barriers such as work-life balance challenges and gender biases that could limit their engagement with the latest

myopia management techniques (Galsanjigmed and Sekiguch, 2023). Moreover, there could be differences in risk-taking and innovation adoption tendencies between genders, with males potentially being more inclined to experiment with and implement new strategies. These combined factors likely contribute to the observed higher uptake of myopia control strategies among male ECPs in Lurambi constituency.

Type of Clinic

The equal distribution of the uptake of myopia control strategies among ECPs in private and public clinics, suggests that both sectors are equally committed to addressing the myopia epidemic. This parity can be attributed to several factors. Firstly, the standardization of professional training and continuous education ensures that ECPs across both sectors are equipped with similar knowledge and skills regarding the latest myopia control techniques (MOH, 2022). Moreover, the availability of resources and access to modern myopia management tools may be comparable in both private and public settings, reducing discrepancies in the ability to implement these strategies (Muma and Obonyo, 2021). The competitive nature of healthcare services could also drive both private and public clinics to stay updated of current best practices to meet patient expectations and improve outcomes. Thus, the balanced uptake reflects a collective effort across different types of clinics to integrate myopia control strategies for better eye health outcomes in the community.

Years of Experience

The uptake of myopia control strategies among ECPs with less than 5 years of experience was the most which was in keeping with age as discussed above. Similarly, ECPs with less than 5 years of experience are typically more recently trained, and therefore, more likely to be familiar with the latest research,

technologies, and recommended practices in myopia management (Press,2019). Their education likely emphasizes current trends and the importance of early intervention in myopia control. Furthermore, younger professionals are often more adaptable and eager to implement new strategies to establish their careers and differentiate themselves in a competitive field (Herrity, 2023).

In contrast, ECPs with more years of experience may rely more on traditional methods that have worked for them in the past. They may be slower to adopt new techniques due to established routines, a preference for familiar practices, or skepticism about the efficacy of newer methods. Additionally, ECPs with extensive experience might face more administrative responsibilities, reducing their time and inclination to stay updated with the latest advancements (Genesh, 2024).

Type of cadre ECPs were practicing

The adoption rate was equally higher among optometrists and optometry technologists as compared to optometrist doctors, ophthalmic officers and ophthalmologists. These differences in the uptake of effective myopia control strategies can be explained by the specific roles and focuses of these professions. Optometrists and optometry technologists are often on the front lines of primary eye care, frequently encountering myopia in its early stages and thus being more motivated to implement control strategies (McCrann et al., 2019). Their training is typically more focused on practical, preventive, and corrective measures, making them more adept and proactive in adopting new techniques to manage myopia (MOH, 2022).

In contrast, optometrist doctors and ophthalmic officers, while still involved in myopia management, may have broader responsibilities that encompass a wider range of eye health issues, potentially diluting their focus on myopia control (Genesh, 2024). Their roles might also involve more administrative duties and less direct patient interaction, limiting their engagement with the latest myopia

control practices. Ophthalmologists, who generally deal with more severe and complex eye conditions requiring surgical interventions, might prioritize other aspects of eye health over myopia control, particularly for mild to moderate cases typically managed by optometrists and technologists (Churchill and Gudgel, 2024). Furthermore, the hierarchical nature of medical professions might mean that ophthalmologists being more senior eye care providers are less involved in the routine management of myopia, relying on optometrists and technologists for these tasks (Yang et al., 2022). This division of labor and focus explains the higher adoption rates among optometrists and optometry technologists compared to other ECPs in Lurambi Constituency.

5.1.1.2 General Uptake of Myopia Control Strategies among ECPs

The uptake of myopia control strategies among ECPs in this study within a smaller constituency was 86.3%, higher than the 80% reported in a study from Singapore a country (Yang *et al.,* 2022). However, this discrepancy may be still be attributed to the sample sizes of the two studies; the Singapore study included 130 ECPs, while this study enrolled only 22 ECPs. Smaller sample sizes can result in greater variability in results, as individual responses have a more significant impact on the proportions (Bhattacharyya, 2018). Additionally, differences in inclusion criteria for ECPs may have contributed to the variability in uptake. This study included ophthalmologists, optometrist doctors, optometrists, ophthalmic officers, and optometrist technologists who are capable of diagnosing and managing myopia. In contrast, the Singapore study included ophthalmologists, optometrists, opticians, and optometry students. Optometry students might not be fully knowledgeable about all myopia control strategies, their efficacies, and the risks associated with inadequate myopia management. In addition, the scope of practice for opticians in Singapore is limited to refraction, prescription, and dispensing of spectacles without the comprehensive management required for effective myopia control, such as axial length measurement and fundus examination (George *et al.,* 2019).

Regarding specific myopia control strategies, this study reported the uptake of single vision spectacles were the most adopted MCS, followed by moderate adoption of bifocal progressive spectacles. Ortho-K contact lenses, medium-dose atropine and multi-segment spectacles had no uptake. The uptake of traditional single-vision spectacles by ECP in this study was higher than the 22.8% reported by Tiago et al. in Portugal (Tiago *et al.,* 2023). This higher uptake in this study could be due to the availability, affordability, and convenience of single-vision spectacles (Burnett *et al,* 2021). However, in children who are fitted with single-vision spectacles, their myopia progresses predisposing them to irreversible eye-related conditions that eventually leave them visually impaired (Sankaridurg *et al,* 2021; Spillmann, 2020).

The uptake of various myopia control strategies in this study was lower than the uptake reported in an international survey, which found 52% uptake of soft and rigid contact lenses among contact lens fitters and 12% among non-fitters across 19 European countries, six Asian countries, 16 from from the USA, and two African countries (Efron *et al.,* 2020). Eppenberger and Sturm (2023) reported uptake rates of 17% for defocus-incorporated multiple segments (DIMs), 29% for multifocal contact lenses, and 60% for low-dose atropine in Europe. Erdinest *et al.,* (2022) found an uptake of 40% for peripheral defocus lenses, 38% for soft contact lenses, and 13% for atropine eye drops (Erdinest *et al.,* 2023). Yang *et al.,* (2022) reported a 53.1% uptake of atropine eye drops. In comparison to these international findings, the uptake of myopia control strategies in my study was significantly lower across all categories, highlighting the potential differences in awareness, accessibility, and acceptance of these interventions in Lurambi Constituency, Kenya.

Despite the reported efficacy of multifocal contact lenses at 25-72% and Ortho-K contact lenses at 44% (Aller *et al.,* 2014; Vincent *et al.,* 2021). This study found no uptake of multifocal contact lenses or orthokeratology (Ortho-K) lenses. Factors contributing to this low uptake include the possibly lower skill levels

among ECPs in Lurambi Constituency for fitting these lenses, lack of local laboratories to supply the appropriate lenses, and a preference among ECPs for other myopia control strategies perceived as more effective. Additionally, the challenge of maintaining proper hygiene and handling of contact lenses, especially for the teenage population, and the dusty environmental conditions of Lurambi Constituency, likely contributed to the low uptake.

Pharmacological use of low-dose atropine eyedrops (0.01-0.05%) has been reported to have high efficacy at 57% with minimal rebound effects (Fu *et al.*, 2020). However, its uptake in this study was low. This may be because in Kenya, atropine eye drops are primarily used by ophthalmologists for medical purposes, while other cadres such as optometrists, optometrist doctors, optometry technologists, and ophthalmic clinical officers mainly use atropine eye drops for cycloplegic refraction (Muma and Hensraj, 2024). In contrast, in Singapore, atropine eye drops are widely used for both refraction and myopia control among ECPs (Yang *et al.*, 2022).

The study's observation that single-vision spectacles are a major strategy being prescribed by ECPs raises critical concerns about the focus of current myopia management practices. While SV spectacles are widely recommended due to their simplicity, accessibility, and cost-effectiveness, it is essential to recognize that their primary function is vision correction, not myopia control. This distinction is crucial because correcting vision does not equate to slowing the progression of myopia, which is the goal of myopia control strategies. The high uptake of SV spectacles among teenagers may reflect a broader issue within the practice. ECPs might be prioritizing immediate visual correction over long- term myopia management. This could be due to a tendency to adhere to traditional practices that emphasize vision correction.

5.2 Knowledge in Uptake of Various Myopia Control Strategies among Teenagers and ECPs

5.2.1 Teenagers

Knowledge acquisition, retention, and utilization regarding myopia control strategies among teenagers were assessed in this study. The study explored local knowledge, beliefs, and awareness of the risks associated with myopia management. The majority of teenagers reported having good knowledge about myopia control strategies. Those who had adopted myopia control measures exhibited a better understanding of these strategies compared to those who had not adopted MCS.

The difference in knowledge levels between teenagers who adopted myopia control strategies and those who did not can be attributed to several factors, including personal experience, direct medical guidance, and proactive educational initiatives. Teenagers diagnosed with myopia are more likely to seek information and adhere to recommended strategies due to direct involvement in managing their condition (Sankaridurg *et al.,* 2021). This proactive approach is often reinforced by personalized education from ECPs and supportive input, further enhancing their understanding and application of myopia control strategies. Additionally, schools and health programs frequently target these individuals with myopia with specific educational resources, reinforcing their knowledge (Tariq *et al.,* 2023).

This study supports the findings from RavenStijn *et al.*, who reported a 44% good knowledge rate among myopia patients in the Netherlands, as well as Vankudre and Noushad, who found a similar proportion among public school students in Oman (RavenStijn *et al.*, 2023; Vankudre and Noushad 2021). Studies in Gondar City, Ethiopia (Assefa *et al.*, 2021) also reported good knowledge rates of 63% and 53.8%, respectively. These positive knowledge rates across these diverse regions suggest the effectiveness of increased awareness and education

campaigns about myopia and its management internationally.

Targeted community health initiatives in Lurambi Constituency have played a crucial role in spreading awareness among teenagers. In Netherlands, advanced healthcare infrastructure and access to specialized eye care have ensured well-informed patients (Ahmed *et al.,* 2023). Public school students in Oman benefit from integrated health education programs, fostering early understanding of eye health (Kanna and Murthy, 2017). Similarly, educational institutions and non-governmental organizations in South Africa and Gondar City, Ethiopia have emphasized regular eye check-ups and myopia control strategies, contributing to positive knowledge outcomes (Belete *et al.,* 2016; Xulu- Kasaba *et al.*, 2021).

Contrastingly, the current study disagrees with findings by Chikasirimobi et al., who reported very low knowledge about contact lenses among patients at the Academic Vision Center (AVC) of Kakamega (Chikasirimobi *et al.,* 2022). Ferdiana et al. also observed poor knowledge regarding myopia and its management among students in Nusa Tenggara Barat Province, Indonesia (Ferdiana *et al.,* 2021). Additionally, a study among undergraduate students in Ghana revealed that 66% of the population was unaware of the use of spectacles to relieve ocular symptoms (Vankudre and Noushad, 2021).

Several factors account for these differences. The current study focused on teenagers attending clinics in Lurambi Constituency, where all teenagers with myopia are diagnosed and educated about myopia and its management by ECPs, justifying the high positive knowledge rate. In contrast, the low knowledge among contact lens users in Kakamega may justify the low prevalence of contact lens use (1.1%) in the area (Chikasirimobi et al., 2022). In Ghana, the majority of undergraduates' unawareness about the use of spectacles highlights a gap in public communication and accessibility to eye care services.

This present study found that most teenagers were aware of single-vision spectacles, soft and rigid contact lenses, which reflects the widespread availability

and promotion of these vision correction methods. Single-vision spectacles are commonly prescribed for general vision correction, making them familiar to a broad audience, including teenagers. The awareness of contact lenses, both soft and rigid, suggests that these options are also well-publicized and accessible, potentially due to their popularity among individuals seeking alternatives to spectacles.

The relatively high awareness of progressive segmented spectacles among teenagers indicates exposure to more advanced myopia control options, which may be recommended by ECPs for myopia cases and its progression. However, the fact that some teenagers were aware of gentamycin eye drops, despite it not being a recognized myopia control strategy, shows a gap in knowledge regarding various myopia control strategies. Gentamycin is an antibiotic typically used to treat bacterial infections rather than for myopia control (Chaves and Tadi, 2024).

The primary source of information about myopia control strategies was eye clinicians. Underscoring the role of ECPs as key influencers (Yang et *al.,* 2022). Moreover, ECPs are often the first point of contact for individuals experiencing vision issues making them a trusted source of information and guidance. They provide comprehensive eye examinations, diagnose myopia and are well-equipped to explain various myopia control strategies among teenagers. Their ability to offer detailed advice based on individuals' specific needs and eye health status ensures that the information is relevant and actionable. Moreover, the credibility and authority of ECPs encourage teenagers and parents to take their recommendations seriously, leading to better awareness and adherence to the myopia control strategy. These direct and professional interactions help bridge the knowledge gap and empower teenagers to manage their myopia effectively.

Majority of teenagers with myopia in this study was using myopia control strategies to improve their vision as a provided reason for using myopia control strategies. This may also be attributed to the alarming prevalence of myopia of

7.5% within the study region (Ragot et al., 2020). It also, reflects concerns among teenagers and their guardians about the immediate need to enhance visual clarity for academic activities, necessitating the practical and essential nature of vision corrections.

There was a significant relationship between the level of knowledge about myopia control and the actual uptake of these strategies. This indicates that the adoption of these strategies is not due to random chance but is likely influenced by specific factors that are effectively addressed by these interventions. Factors contributing to this relationship could include increased awareness and education about myopia and its consequences. The availability and accessibility of certain myopia control strategies significantly influence teenagers' knowledge and their decisions to adopt these strategies (Burnett *et al.*, 2021).

5.2.2 ECPs

All ECPs reported having good knowledge about myopia control strategies, regardless of their uptake status. Australian Optometrists were similarly aware of myopia control strategies (Douglass *et al.*, 2020). Yang *et al.*, (2022) reported that Singaporean optometrists were aware of myopia control strategies. This study agrees with Tchiakpe *et al.*, (2017) that found 95.8% of ECPs knew about contact lenses as a myopia control strategy in Ghana. Muma and Hesraj reported that 100% of the ECPs were aware of the use of approximately 1% atropine eye drops (Muma and Hesraj, 2024). The similarity in high levels of knowledge about myopia control strategies among ECPs may be due to the promising research evidence supporting these interventions. However, ECPs of Lurambi Constituency may be aware of these strategies, but they are not necessarily implementing them in their practice. Moreover, although Muma and Hesraj (2024) reported good knowledge about the use of 1% atropine eye drops, this contrasts with clinical practice, where 1% atropine is not typically used for myopia control. This discrepancy highlights a gap in knowledge regarding

appropriate myopia control strategies, suggesting a lack of accurate understanding in this area.

Despite high knowledge in the uptake of myopia control strategies among ECPs there is a knowledge gap on the uptake of effective myopia control strategies. General uptake of effective myopia was at 86.36% with single vision spectacles being the most prescribed vision correction with minimal uptake of multifocal contact lenses and Ortho-K CL. This is concerning as regarding efficacies of various myopia control strategies such as multifocal CL which is reported to control myopia to within a range of 25-72% (Aller, 2014) while ortho-K CL was recently reported to slow down myopia progression by 44% (Vincent *et al.*, 2021).

Studies have reported executive bifocals to control myopia with a 50% reduction, progressive addition lenses, 11 to 33% reduction and peripheral defocus spectacles with only a 10% reduction (Cho et al, 2019; Pepose et al, 2009; Wildsoet et al., 2019). Low- dose atropine (0.01-0.05%) has been reported to control myopia with up to 57%, medium- dose atropine (0.1-0.25%) up to 60% (Chen et al, 2010; Marcus and Wong, 2020.) Multifocal spectacles lenses and the use of combination treatment involving two or more of the aforementioned control strategies were equally found to be effective resulting in myopia reduction by about 57% and 50% respectively (Pineles *et al.*, 2017). Therefore, despite the high uptake of myopia control strategies in this study, the uptake of effective myopia control remains to be low.

The low uptake of effective MCS beyond single-vision lenses can be attributed to several factors that ultimately impact the uptake of these strategies. ECPs may possess a general awareness of the importance of myopia control but lack in-depth understanding and specialized training in the latest evidence-based interventions. This superficial knowledge might stem from limited access to updated clinical guidelines and educational resources, leading to reliance on outdated information. Additionally, resource constraints, such as the

unavailability of necessary equipment or medications, may discourage ECPs from focusing on myopia control, further contributing to the gap between their general knowledge and the practical application of specific strategies.

All ECPs in this study sample indicated that the minimum age to prescribe single vision (SV) spectacles, bifocal spectacles, progressive spectacles, multifocal contact lenses (CL), low-dose atropine, and combination treatments was between 7.5 and 8 years. High-dose atropine was considered appropriate for children at a mean age of 8.7 years, in agreement with Martinez-Peréz et al., that also found 8.0±2.4 years, as well as Wolffsohn et al., reported a minimum age of 8.0±4.2 years (Martinez-Peréz et al., 2023; Wolffsohn *et al.*, 2020). These observations may be informed by the fact that it is possible for myopia can start developing as early as the age of six years and progress until adolescence (Bullimore and Richdale, 2020). During this process, the eyeball elongates in excess and with increased speed and less commonly the cornea or lens becomes too steep (Rozema et al., 2023). Therefore, starting a myopia control strategy at these age groups helps to slow myopia progression, since its progression has been linked to irreversible eye-related conditions (Enrique et al., 2021).

However, the studies by Martinez-Peréz *et al.,* (2023) and Wolffsohn *et al.*, (2020) that suggest instituting myopia control at eight years of age may not be optimal, as emerging evidence strongly supports earlier intervention, ideally starting at six years old. Research shows that the progression of myopia is more rapid in younger children, particularly between the ages of six and eight years (Tricard *et al.,* 2022). Early intervention during this critical period can significantly slow down the progression of myopia, reducing the risk of developing high myopia and associated complications later in life (Bullimore *et al.,* 2021). For instance, Donovan et al. demonstrated that earlier initiation of myopia control strategies is associated with better outcomes in reducing the rate of myopia progression (Donovan *et al.,* 2012). Furthermore, a study by Chua et al. highlighted that starting interventions such as low-dose atropine at younger

ages resulted in a more substantial slowing of myopia progression compared to starting at an older age (Chua *et al.*, 2016). Therefore, while the studies suggesting control at eight years recognize the importance of intervention, they may underestimate the benefits of starting even earlier. It is crucial to emphasize that beginning myopia control at eight years old may be too late to achieve the most effective outcomes, and strategies should be implemented as early as possible, ideally around the age of six years.

The majority of ECPs were well-informed about MCS and typically recommended prescribing myopia control measures when myopia reached a minimum level of -0.50 to -0.75 diopters (Ds), with similar criteria for myopia progression (0.50-0.75 Ds per year). ECP also suggested follow-up intervals of 4-6 months. Similarly, Erdinest *et al.*, and Wolffsohn *et al.*, reported ECPs agreed that 0.50-0.75Ds was the minimum amount of progression with the difference in follow-up over six months (Erdinest *et al.*, 2023; Wolffsohn *et al.*, 2020).

The decision to adopt a minimum refractive error threshold of 0.50 to 0.75 diopters (Ds) as the starting point for myopia control strategies is well-founded and consistently sup- ported by studies across various continents. This threshold is justified primarily by the clinical significance of early intervention, which has been shown to effectively slow the progression of myopia in its nascent stages (Brennan *et al.*, 2021). Early intervention is crucial as even low levels of myopia can quickly escalate to higher, more problematic degrees, increasing the risk of severe ocular complications such as retinal detachment, glaucoma, and myopic maculopathy (Enrique et al., 2021). Wolffsohn et al reported that myopia progression is most rapid during the early stages, particularly in children and adolescents (Wolffsohn et al., 2020). By initiating control measures at -0.50 to -0.75 Ds, ECPs may address myopia before it accelerates. Furthermore, the consistency of findings from research conducted in diverse regions, including Asia, Europe, and North America, underscores the universal applicability of this threshold. Clinical guidelines, based on a synthesis of these global findings, support this

threshold, emphasizing its evidence-based nature. Thus, adopting a minimum threshold of -0.50 to -0.75 Ds for initiating myopia control is a strategic, preventative measure that reflects the consensus of the global eye care community on the benefits of early and proactive myopia management.

Most ECPs in Lurambi constituency preferred a follow-up interval of four to six months for myopic children who have adopted a myopia control strategy. This preference may be justified by the need for closer monitoring to promptly detect and address any changes in refractive error or ocular health (Brennan et al., 2021). In, addition, given the rapid progression of myopia in children, shorter follow-up intervals enable ECPs to make timely adjustments to treatment plans, ensuring that the chosen strategies remain effective and any complications are swiftly managed.

The systematic review by Wolffsohn et al., (2020) including regions such as Africa, Asia, Australia, Europe, the Middle East, North America, and South America, suggests a follow- up period of over six months. This broader recommendation might be influenced by a variety of factors, including differences in healthcare infrastructure, access to eye care services, and the varying rates of myopia progression across populations. A more extended follow-up period proposed by Wolffsohn et al. may be suitable for regions with well-established myopia management protocols and reliable patient adherence to treatment plans. However, in Lurambi Constituency, the preference for more frequent follow-ups reflects a pragmatic approach to managing myopia in a context where closer supervision can help mitigate rapid progression and ensure optimal outcomes for young patients.

There was no association between knowledge in the uptake of myopia control strategies and uptake of myopia control strategies. The absence of an association between the knowledge of myopia control strategies among ECPs in Lurambi Constituency and the actual uptake of these strategies, suggests that factors other

than knowledge alone may play a significant role in the adoption of myopia control practices. Possible contributing factors could include resource availability, practitioner workload, patient demand, economic considerations, accessibility to advanced myopia control technologies, and institutional support for implementing these strategies. Furthermore, even with adequate knowledge, ECPs might face practical barriers such as a lack of training on new techniques, uncertainty about the efficacy of these strategies, or resistance to change from established practices. Therefore, the decision to implement myopia control measures appears to be influenced by a complex interplay of practical and contextual elements beyond mere knowledge.

5.3 Attitude in Uptake of Myopia Control Strategies among Teenagers and ECPs

5.3.1 Teenagers

Attitude is defined as a psychological tendency that is expressed by evaluating a particular decision with some degree of favor or disfavor. This was inclined to individual feelings and inclination toward myopia control strategies (Ferdiana *et al.*, 2021). The majority of teenagers reported good attitude regardless of uptake status.

The relatively good attitude towards myopia control strategies among teenagers with up- take of myopia control strategies and good attitude among those without uptake may be attributed by increased community initiatives and medical camps regarding MCS (Almu- jalli *et al.*, 2020). These efforts, often led by local health authorities and schools, aim to ensure that teenagers are well-informed about the benefits of myopia control. Secondly, ECPs who actively engage with teenagers during routine eye check-ups play a crucial role (Yang *et., al* 2022). ECPs not only diagnose and manage myopia but also emphasize the importance of adhering to control strategies, fostering a fair and good attitude among their patients. Lastly, the high prevalence of myopia in the Lurambi region (Ragot et al., 2020), might heighten awareness and concern among teenagers and their families, driving a more favorable attitude toward any measures that could mitigate the progression of the condition.

This study is in agreement with a study in Nusa Tenggara Indonesia that found student's attitudes towards glasses to be moderately fair, 78.8% disagreed that glasses could worsen vision, 60.6% disagreed that wearing glasses was uncomfortable and 60.9% disagreed that glasses could worsen their vision, 60.6% disagreed that wearing glasses was uncomfortable and 60.9% disagreed that wearing glasses restrict their activities (Ferdiana et al 2021). Among public schools in Gondar City, Ehiopia good attitude was at 52.1% towards spectacles

while Nyamai et al., in a study among students attending public high schools in Nairobi County found a good attitude towards spectacles use (Assefa et al., 2021, Nyamai et al 2016). Nyamai et al observed that at the teenage stage where conforming to the group is the norm and wearing spectacles may be a source of teasing (Nyamai et al., 2016). However, the above-mentioned studies in Indonesia, Oman, Ehiopia and Kenya contradict the norm by attributing a good attitude towards myopia control strategies highlighted above to the growing trend of spectacles among celebrities popular to this age group (Assefa et al., 2021; Ferdiana et al., 2024; Nyamai *et al.*, 2016).

However, University students in Oman, the study found a good attitude toward myopia control strategies at 53.5%, a poor attitude at 36.5% and a fair attitude at 10% (Vankudre and Noushad, 2021). This study is particularly noteworthy as it is one of the few that directly examines attitudes toward myopia control strategies, as opposed to the more commonly studied topic of spectacle use for myopia correction. The findings underscore the variability in attitudes within a population, which can influence the overall uptake of myopia control measures. For instance, a good attitude among a majority might drive higher adoption rates of strategies such as orthokeratology or atropine eye drops, while a poor or fair attitude could hinder widespread acceptance and utilization. In comparison to other studies that primarily focused on the uptake of spectacles, this study by Vankudre and Noushad offers a broader perspective on the challenges and opportunities in promoting myopia control strategies. It highlights the need for targeted education and awareness programs to improve attitudes and, consequently, the adoption of effective myopia management practices. This insight is crucial for understanding the context of your study in Lurambi Constituency, where similar dynamics might be at play, and where efforts to enhance specific knowledge and attitudes toward myopia control could significantly impact the uptake of these strategies.

The similarity in good attitude is attributed to several converging factors. Firstly,

across these diverse regions i.e. Nussa Tenggara in Indonesia, Oman, Godar City in Ethiopia and Nairobi County increased awareness and targeted educational campaigns have played a crucial role in shaping good attitudes towards eye health interventions. Health education programs integrated into school curricula and community health initiatives ensure that students understand the importance of managing myopia effectively. Secondly, the in- volvement of ECPs in these regions provides authoritative and personalized guidance, re- inforcing good attitudes through routine interactions and consistent messaging about the benefits of using corrective measures. Additionally, the prevalence of vision problems in these regions heightens awareness and concern among students and their families, leading to a greater appreciation of the importance of spectacles and myopia control strategies. Thus, a combination of education, professional influence and personal experience drives similar good attitudes towards myopia control strategies and spectacles among teenagers in Lurambi and their counterparts in Nusa Tenggara, Oman, Gondar City, and Nairobi County.

The absence of a significant association between teenagers' general attitudes and the up- take of myopia control strategies, suggests that broader perceptions or general opinions do not play a decisive role in whether or not these strategies are adopted. However, significant relationships were found for specific factors, such as the use of optical devices for myopia control not affecting appearance and the belief that vision would not worsen during near activities while using a myopia control strategy, highlighting that practical and immediate concerns are more influential. These findings indicate that teenagers are more likely to adopt myopia control strategies if they believe these measures will not compromise their aesthetics or exacerbate their vision problems during common activities. Therefore, targeted information addressing these specific concerns could be more effective in encouraging the uptake of myopia control strategies among teenagers.

5.3.1 ECPs

The majority of ECPs exhibited a positive attitude, majority expressed frequent concerns of the rising incidence of pediatric myopia in clinical practice. Most were proactive in considering myopia control strategies in their clinical approaches. Omar et al reported in these situations of consensus this is likely to come from comprehensive training and awareness programs highlighting the importance of myopia control in improving patients' quality of life and reducing the risk of severe ocular complications (Omar *et al.*, 2024). The collaborative nature of the eye care community further reinforces this good attitude, as ECPs may be influenced by peer support and success stories from early adopters. Consequently, even those yet to implement these strategies recognize their potential value, contributing to a universally good attitude towards the uptake of effective myopia control strategies. Moreover, continued medical education emphasizes evidence-based practices, fostering a supportive environment for embracing innovative treatments (Press, 2019).

A considerable number of ECPs indicated that they sometimes prescribed single-vision spectacles as a strategy to mitigate myopia progression. Studies by Coverdale et al. and Wolffsohn et al. found that their ECPs also sometimes prescribed single-vision spectacles to young myopes (Coverdale *et al.*, 2024; Wolffsohn *et al.*, 2019). However, research has shown that children fitted with single-vision spectacles or contact lenses experience myo- pia progression, which can predispose them to visually threatening conditions and poten- tially lead to visual impairment (Flicroft *et al.*, 2020; Sankaridurg *et al.*, 2021).

Most of the ECPs noted a significant or considerable impact on patient loyalty, practice revenue, and job satisfaction due to changes in myopia management. Similarly, studies in Europe by Martínez-Pérez et al. and Wolffsohn et al. found that their ECPs experienced enhanced patient loyalty, increased practice revenue, and improved job satisfaction when prescribing various myopia control strategies

to their patients (Martínez-Pérez *et al.*, 2024 and Wolffsohn *et al.*, 2023). This may be attributed to the positive visual outcomes achieved through these myopia control methods.

Most of the ECPs reported a low concern regarding an increase in pediatric myopia cases. Similar findings were observed in Israel among ECPs who reported a low concern regarding myopia in general (Erdinest et al., 2023). This similarity is attributed to the fact that there are no national guidelines on myopia control and its strategies both in Israel and Kenya. Moreover, insufficient emphasis on myopia management in professional training programs have led to a gap in knowledge and practice among ECPs.

This study disagrees with Jorge &Jesus, 2022 that reported a very high level of concern about the increasing prevalence of myopia while in Portugal, Tiago et al., reported that 29.5% of ECPs reported a high level of concern regarding an increase in pediatric myopia cases (Tiago et al., 2023). Similarly, Martinez-Perez et al. reported a very high level of concern about the increasing frequency of pediatrics across all six continents (Martinez- Perez et al., 2023), Kumar et al., reported the rate of myopia progression of children with the patient's current refractive errors was the essential consideration with almost 80% of optometrists rating it as very important (Kumar et al., 2023). The high level of concern by ECPs about myopia control strategies could be because of the increasing prevalence of myopia and available treatment options (Flitcroft et al., 2019). However, ECPs in Lurambi Constituency had a low concern regarding the rise in pediatric myopia and are not active in myopia control which is attributed by lack of awareness and education among ECPs about the long-term implications of untreated myopia in children, such as the increased risk of developing severe eye conditions later in life. Despite the difference in the prevalence of myopia in different regions, the prevalence of myopia is on the rise in all regions.

5.4 Factors Influencing Uptake of Myopia Control Strategies among Teenagers and ECPs

5.4.1 Teenagers

The factors influencing the uptake of myopia control strategies included the availability and suitability of these strategies, their cost, the preference of ECP, and the perceived effectiveness of the strategy. However, the preferences of parents, the risk of myopia progression, and the preferences of patients did not significantly impact the uptake of myopia control measures.

ECP preference was among the most influencing factor in the uptake of myopia control strategies. This may attributed to the fact that ECPs are the key influencers in the uptake of myopia control strategies (Yang *et al.*, 2022). ECPs are often the first point of contact for individuals experiencing vision issues making them a trusted source of information and guidance. They provide comprehensive eye examinations, diagnose myopia and are well-equipped to explain various myopia control strategies among teenagers. Their ability to offer detailed advice based on individuals' specific needs and eye health status ensures that the information is relevant and actionable. Moreover, the credibility and authority of ECPs encourage teenagers and parents to take their recommendations seriously, leading to improved awareness and adherence to the myopia control strategy.

The effectiveness of the strategy and the availability of the strategy influenced the uptake of myopia control. These identified factors agree with Wolffsohn et al.'s systematic review across Asia, Australia, Europe, North America and South America (Wolffsohn *et al.*, 2016). This similarity suggests that the challenges and outcomes experienced by Lurambi Constituency are consistent with global patterns identified in the review. The convergence of results highlights that despite geographical and cultural differences, certain strategies can yield comparable effectiveness. Moreover, the availability of various myopia control strategies remains a significant problem among teenagers in Lurambi Constituency due to

several inter-related factors. Firstly, economic constraints limit access to advanced myopia control measures, such as specialized contact lenses or orthokeratology, which can be prohibitively expensive for many families (Agyekum *et al.,* 2023). Additionally, there is often a lack of awareness and education about myopia and its long-term consequences among both parents and teenagers, reducing the perceived urgency of seeking preventive care. Healthcare infrastructure in the region may also be inadequate, with limited availability of trained ECPs and diagnostic facilities. Moreover, cultural factors and misconceptions about vision health can further hinder the acceptance and utilization of available strategies. These challenges collectively create a scenario where, despite the existence of effective myopia control methods, their implementation and accessibility for teenagers in Lurambi remain constrained, perpetuating the prevalence of unmanaged myopia in the community.

The cost of adopting various myopia control strategies in Africa remains the major barrier. This study found that cost influenced the uptake of various myopia control strategies. Similar to other studies in South Africa, Nigeria, Nakuru and Kenya found the cost to be similar barrier (Naidoo et al., 2018; Megbelayin, 2013; Bastawrous et al., 2013; Nyamai et al., 2016). This could be because the provision of optical services in Africa has remained largely in the hands of the private sector making the strategies usually unaffordable for the vast majority of those who need them.

Parent preference, risk of myopia progression, and patient preference did not impact the uptake of myopia control strategies. Contrary, to other studies that found the uptake of myopia control strategies to have been influenced by the risk of myopia progression among teenagers in UK, Spain, East Asia, Middle East, India, Latin America, China and Korea (Azuara-Blanco et al., 2020; Zloto et al., 2018). In these areas, high rates of myopia progression among adolescents have heightened awareness and concern among parents, healthcare providers, and policymakers. This widespread recognition of the issue drives the demand for effective myopia management strategies. In East Asia and China, myopia prevalence is particularly high (Xiang and Zou, 2020; Zhang *et al.,* 2022). Therefore, there

is an intense focus on early intervention and innovative control measures. Similarly, in the UK, Spain, and other parts of Europe, growing evidence of the long-term health change. ECPs

5.4.2 ECPs

According to ECPs, cost was the most influential factor followed by unpredictable effectiveness of strategy and to a lesser extent extra time in the adoption of myopia control strategies. Other studies outside Kenya, agree with this study in that high costs, inadequate information and unpredictable outcomes were similar barriers to the uptake of various myopia control strategies (Martinez-Perez *et al.,* 2019; Martinez-Perez *et al.,* 2023; Wolffsohn *et al.,* 2016).

The cost has been the major barrier regarding the uptake of various myopia control strategies in Africa and Europe. In Europe, advanced myopia control methods such as orthokeratology lenses, pharmaceutical treatments, and specialized spectacles can be expensive and are frequently not covered by national health services or insurance (Tariq *et al.,* 2023). This out-of-pocket expense can be prohibitive for many families, especially those from lower socio-economic backgrounds. In Africa, the financial challenge is even more pronounced due to generally lower income levels and less comprehensive healthcare infrastructure (Oleribe *et al.,* 2019). Many families cannot afford even basic eye care services, therefore seeking for advanced myopia control strategies may be a double challenge to them. Additionally, there is often limited availability of such treatments in rural and underserved areas, exacerbating the access problem. Thus, the high cost of myopia control strategies in both continents creates a significant barrier, preventing widespread adoption and leaving many teenagers at risk of unmanaged myopia progression.

Moreover, uncorrected myopia has been reported to produce an overall loss of productivity of over 202 billion US-dollars annually worldwide since it is well established that the higher the myopia and longer axial length becomes, the higher

the lifetime risk of developing ocular complications (Enrique *et al.*, 2021). Although high myopia carries the highest risk of complications and visual impairment, low and moderate myopia also have progression and are expected to reduce the rate of ocular pathologies associated with myopia and consequently the cost of treating myopia-related complications. Data regarding the cost implication of myopia and its management is lacking, therefore future studies are needed to generate more homogenous cost data and provide a complete picture of the global economic cost of myopia.

Inadequate information regarding various myopia strategies also remains to be a factor in Africa. There has been insufficient dissemination of information regarding effective myopia control strategies to potential patients. Therefore, there is a need for the ophthalmic division of Kenya to conduct campaigns on the importance of reducing myopia progression through the use of effective myopia control strategies that are expected to increase the adoption of myopia control strategies. Furthermore, momentarily, a consensus of even clear myopia control guidance is missing in Kenya. However, currently, International Myopia Institute (IMI) and other expert groups have established a clinical guideline for myopia management (Gifford, 2019).

Another factor cited was of insufficient consultation time, which was reported in India by Kumar et al., 2023. Insufficient consultation time may be attributed to the dense population of Lurambi Constituency. The Indian population has been densely populated with 1.4171 billion while in Lurambi Constituency at 290,343 (KBS, 2019; WB, US Census Bureau 2024). This dense population translates to the high number of patients who are seen by the ECPs and this reduces the consultation time of each patient. This time constraint hampers the ability of ECPs to thoroughly educate patients and their families about myopia control options, including their benefits, usage, and long-term implications. Comprehensive discussions are essential for conveying the importance of these strategies and addressing any concerns or misconceptions. Without adequate time,

ECPs may struggle to build the necessary trust and understanding with patients, resulting in lower acceptance and adherence to prescribed myopia control methods. Additionally, the complexity of some advanced myopia treatments requires detailed explanation and follow-up, which is not feasible in rushed appointments. Therefore, the lack of sufficient consultation time undermines the effective communication and patient education needed for the successful adoption of myopia control strategies in dense populations. With 1.4171 billion while in Lurambi Constituency at 290,343 (KBS, 2019; WB, US Census Bureau 2024). This dense population translates to the high number of patients who are seen by the ECPs and this reduces the consultation time of each patient. This time constraint hampers the ability of ECPs to thoroughly educate patients and their families about myopia control options, including their benefits, usage, and long-term implications. Comprehensive discussions are essential for conveying the importance of these strategies and addressing any concerns or misconceptions. Without adequate time, ECPs may struggle to build the necessary trust and understanding with patients, resulting in lower acceptance and adherence to prescribed myopia control methods. Additionally, the complexity of some advanced myopia treatments requires detailed explanation and follow-up, which is not feasible in rushed appointments. Therefore, the lack of sufficient consultation time undermines the effective communication and patient education needed for the successful adoption of myopia control strategies in dense populations.

5.5 Relationship between the Identified Factors and Uptake of Myopia Control Strategies among Teenagers and ECPs

5.5.1 Teenagers

One a single factor was identified to influence uptake of MCS. An increase in cost decreased the likelihood of adopting MCS. This may primarily be due to the economic considerations of managing long-term ocular health. Parents and guardians, who are often the primary decision-makers for teenagers' health, recognize that investing in effective myopia control strategies can prevent more severe and costly eye problems in the future (Jiang *et al.*, 2022). However, the relatively high cost of these strategies likely correlates with their perceived effectiveness and quality, making them a worthwhile investment. Furthermore, financial incentives or subsidies provided by healthcare programs may also make these advanced treatments more accessible and appealing, thereby encouraging uptake. Consequently, the cost factor, when viewed as an investment in long-term ocular health and reduced future medical expenses (Floo *et al.*, 2021), plays a crucial role in increasing the likelihood of adopting myopia control strategies among teenagers in Lurambi.

5.5.2 ECPs

A direct significant relationship between refractive error and the uptake of various myopia control strategies, when ECPs decided to adopt a myopia control strategy was observed. These emphasize the importance of refractive error as a key criterion in the adoption of these methods. Practitioners are likely to prioritize and adapt myopia control strategies based on the degree of refractive error, recognizing that higher levels of myopia may necessitate more aggressive or immediate intervention to prevent further progression (Russo *et al.*, 2022).

The criteria for selecting initial strategies for young myopes have been found to have direct, significant relationships with binocular vision status and other critical factors. Research, including the IMI (International Myopia Institute) white papers

on the relationship between myopia and binocular vision, underscores that anomalies in binocular vision, such as convergence and accommodative anomalies, can be associated with the onset or progression of myopia. Studies have shown that disruptions in the emmetropization process, potentially caused by hyperopic defocus, can lead to myopia development (Lane, 2022). These findings emphasize the importance of comprehensive assessments that include detailed binocular vision evaluations when determining the most appropriate myopia control strategies. For instance, the IMI white papers have discussed how binocular vision anomalies can exacerbate myopic progression, suggesting that addressing these issues through tailored interventions, such as vision therapy or specialized lens designs, can optimize treatment outcomes. This reinforces the need for personalized approaches in myopia management, where ECPs consider not only refractive errors but also binocular vision status and other clinical indicators to ensure effective and individualized care.

5.6 Concluding Remarks

The study reveals a paradoxical situation where, despite a high overall uptake of myopia control strategies among teenagers and ECPs, the knowledge and attitude towards these strategies remain significantly low. This may highlight the consideration that skewed the results to high uptake being single vision spectacles which may be restoring myopic induced vision loss and although part of myopia care may be control progression. Although the study population are assumed to be using myopia control methods, their understanding of these strategies is lacking, and they may not fully appreciate the benefits or proper use of the interventions. While the use of myopia control strategies is prevalent, there is a critical need to improve education and awareness about these methods to ensure informed decision-making. Additionally, addressing cost-related barriers could further enhance the adoption and effectiveness of these strategies.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter concludes with a synopsis of the main findings of the current study, in addition outlines recommendations of the study. The limitations are located in chapter one in line with MMUST school guidelines (Appendix VIII).

6.1 Conclusions

The uptake of myopia control strategies among teenagers and ECPs of Lurambi Constituency, Kenya (objective i) sought to conclude that, despite the general high uptake of MCS, the adoption of effective myopia control strategies remains very low.

The objective (ii) on knowledge of myopia control strategies among teenagers and ECPs of Lurambi Constituency, Kenya sought to conclude that, although teenagers and ECPs reported good knowledge of myopia control strategies, their knowledge regarding effective myopia control strategies is still very limited.

Objective (iii) on attitude of myopia control strategies among teenagers and ECPs of Lurambi Constituency, Kenya sought to conclude that both teenagers and ECPs demonstrated a positive attitude towards myopia control strategies, regardless of whether they had adopted these strategies or not. However, concern regarding the increase in pediatric myopia cases remains very low among ECPs.

Objective (iv) on factors influencing the uptake of MCS among teenagers and ECPs of Lurambi constituency sought to conclude that, among teenagers and ECPs, cost was identified as the most influential factor affecting the uptake of MCS. The amounts of time required for consultations also played a significant role in determining the adoption of these strategies.

The last objective (v) on the relationship between the uptake of MCS and factors influencing the uptake of MCS among teenagers and ECPs of Lurambi Constituency, Kenya sought to conclude that an increase in cost was associated with a 36.7% decrease in the likelihood of adopting myopia control strategies. No significant associations were observed between factors influencing the uptake of myopia control strategies and their adoption. However, a significant association was found between refractive error and the uptake of various myopia control strategies when ECPs decided to adopt a strategy. Furthermore, the criteria for selecting the initial strategy for myopia control in younger myopes showed significant associations with binocular vision status and other unspecified factors.

6.2 Recommendations

6.2.1 Practice

- The Ministry of Health of Kenya (Ophthalmic division), in partnership with other stakeholders in eye health, should develop a pediatric myopia management guideline/education for utilization by ECPs in Kenya. The guideline should be used by ECPs to scale myopia control among children. Continuous medical education to enlighten ECPs on the significance of myopia control among children and myopia control strategies to be adopted for the control. The suggested myopia control education and guideline is shown in Figure 6.1 below.
- Programs should be targeted to improve the knowledge of teenagers, parents, and teachers, using culturally appropriate and acceptable information materials regarding myopia control strategies.
- Information should be targeted to teenagers with poor knowledge and negative attitudes regarding myopia control strategies, particularly those with low education and low income. Information should contain relevant information as follows:

— the importance of eye health and myopia control in children

— Where, how and how often eye checkups should be performed for children with myopia causes, signs, prevention and effective treatment of myopia in children benefits of using myopia control strategies

— Availability of eye healthcare and various myopia control strategies in primary health centers costs for eye healthcare and myopia control strategies.

- Manufacturers and regulatory bodies should bring various myopia control strategies to the eye care industry for easy accessibility by ECPs and teenagers.

6.2.2. Policy

- Ministry of Health through Ophthalmic division should approve myopia guidelines that should be used by ECPs to support them in changing behavior on myopia management.
- Government should provide various myopia control strategies to children at zero cost to facilitate school screening programs since costs remain major factor in uptake of myopia control strategies.
- The potential cost of preventable visual impairment and future loss of income and the impact of state resources from myopia should warrant MCS as basic mandatory care as well as primary care condition that should be recognized as other eye diseases as glaucoma and diabetic retinopathy.

6.2.3. Future Research

- This study only focused on teenagers of Lurambi Constituency which may not be a true representation of Kenya. A study should be conducted on knowledge, attitude and factors influencing myopia control in the entire Kenya.
- A health economic study/evaluation should be done to understand the cost-effectiveness of using myopia control interventions to prevent myopia-related pathologies. Such a study should consider not only the direct costs but also the impact of chair time, which may be limited due to the availability ECPs.

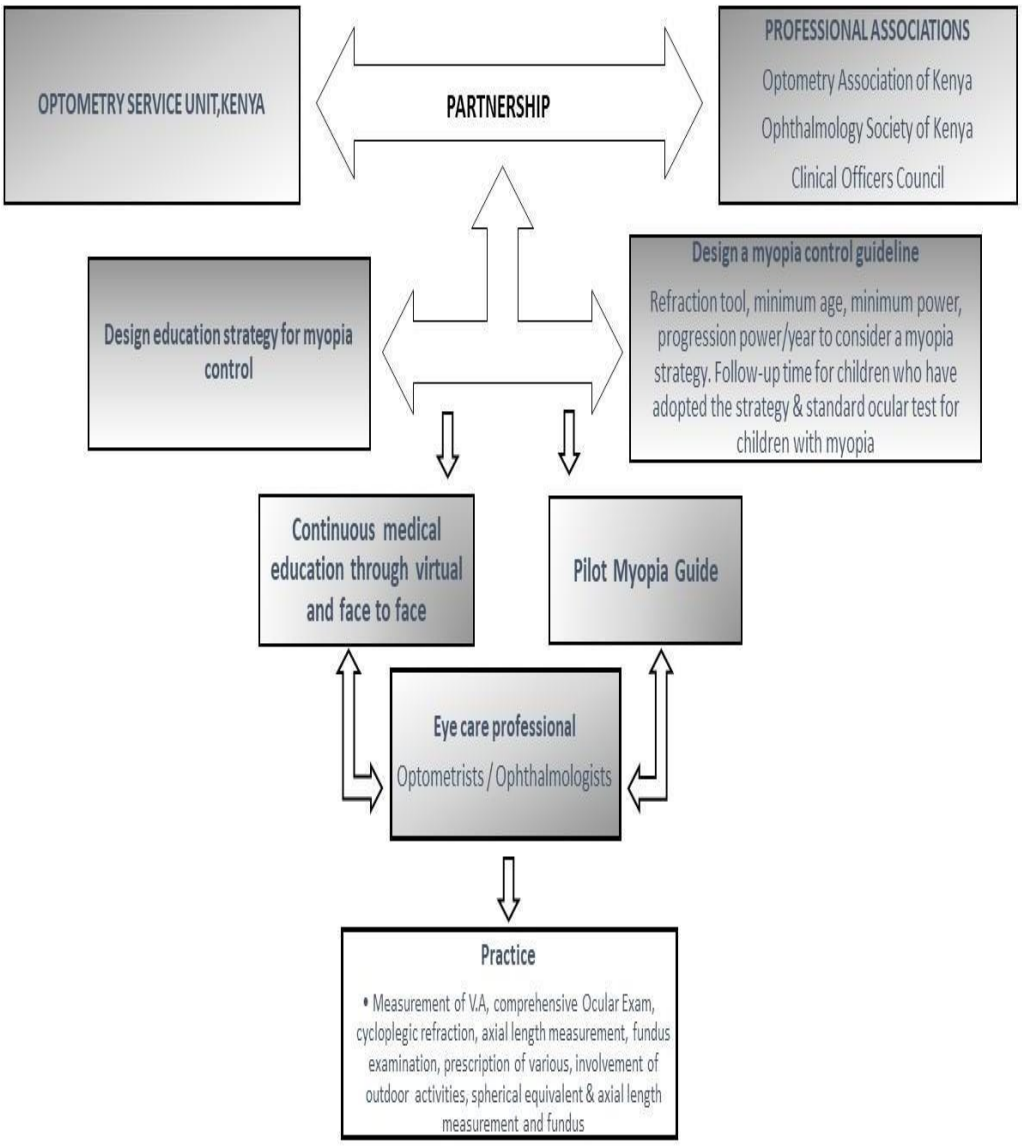

Figure 6.1 Proposed myopia control education/ guideline strategy for effective myopia control strategies among ECPs

Source: Researcher Own Creation

Proposed Myopia Control Education/ Guideline will Work

The Ministry of Health, through its Ophthalmic Division, should collaborate with the Ophthalmologist Society of Kenya, the Optometry Association of Kenya, and the Clinical Officers Association to establish two parallel committees. The first committee should focus on designing an educational strategy for myopia control, which would be delivered through both virtual and face-to-face continuing medical education (CME) sessions. The second committee should be tasked with developing a comprehensive myopia control guideline. This guideline should include details on refraction tools, minimum age requirements, criteria for minimum and progression power per year to consider a myopia control strategy, follow-up intervals for children who have adopted the strategy, and standard ocular tests for children with myopia. The guideline should be piloted and adjusted based on the findings before widespread implementation.

These myopia management education and guideline initiatives may be utilized by ophthalmologists, optometrists, and ophthalmic clinical officers to enhance myopia practice. This includes the measurement of visual acuity, conducting comprehensive ocular exams, cycloplegic refraction, axial length measurement, fundus examination, prescribing appropriate corrective lenses, promoting outdoor activities, and performing spherical equivalent and axial length measurements at every visit as recommended by the World Council of Optometry (WCO), which offers a comprehensive guide to the standard of care in myopia management (WHO, 2022).

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APPENDICES

Appendix 1: Sample Permission Letter for Free Community Eye Screening and Informed Consent

LETTER OF PERMISSION TO CARRY OUT STUDY

Department of Optometry and Vision Science,
Masinde Muliro University of Science and Technology.

(Institution or authority Desired) Dear Sir/Madam,

RE: APPLICATION FOR PERMISSION TO CARRY OUT A RESEARCH STUDY IN YOUR INSTITUTION.

I am a master's student at the Masinde Muliro University of Science and Technology currently conducting a study on **knowledge, attitude and factors influencing uptake of myopia control strategies among teenagers and ECPs in Lurambi Constituency, Kenya.**

I write to seek your permission to conduct research in your eye clinic(s), as a component of the study entails survey questionnaire to children who are aged 13-19 years. The questionnaires to be distributed are to enable the researcher to obtain information for academic research purposes only. The study is aimed at investigating knowledge, attitude and factors influencing the uptake of myopia control strategies among teenagers and ECPs in Lurambi Constituency, Kenya.

The study is further aimed at promoting child eye care services utilization in the County. Information received from the participating children will be treated with the utmost confidentiality. Kindly find a copy of the full study proposal, accompanying this letter of request, for your understanding and knowledge of the study aims, objectives and procedures to be followed.

Your assistance in this, as well as helping in mobilizing your patients (teenagers) and ECPs towards participating in the study exercise, would be of immense help to the success of the study.
Thanking you in anticipation of your approval of this request.

Yours Faithfully, Delilah Sarai
Department of Optometry and Vision Sciences,
Masinde Muliro University of Science and Technology
Researcher.

Prof. Alvin Jeffrey Munsamy Discipline of Optometry, University of KwaZulu-Natal Supervisor.

Dr. Christine Wanjala, PHD Lecturer

Department of Medical Laboratory Sciences

Masinde Muliro University of Science and Technology Supervisor.

Sample Consent Form for Identified Inclusions. Consent Form for

Teenagers

TITLE: KNOWLEDGE, ATTITUDE AND FACTORS INFLUENCING UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS AND EYECARE PRACTIONERS OF LURAMBI CONSTITUENCY, IN KENYA.

RESEACHER: DELILAH SARAI**.**

INSTITUTION: MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY.

SUPERVISORS: 1. Prof. AJ Munsamy

2. Dr. C Wanjala

Introduction.

I would like to tell you about a study being conducted by the above-listed researchers. The purpose of this consent form is to give you the information you will need to help you decide whether your child should participate in the study. Feel free to ask any questions about the purpose of the research, what happens if your child participates in the study, the possible risks and benefits, the rights of your child as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide if you want your child to be in the study or not. This process is called 'informed consent'. Once you understand and agree for your child to be in the study, I will request you to sign your name on this form. You should understand the general principles which apply to all participants in medical research: i) Your child's decision to participate is entirely voluntary ii) Your child may withdraw from the study at any time without necessarily giving a reason for his/her withdrawal iii) Refusal to participate in the research will not affect the services your child is entitled to in this health facility or other facilities.

May I continue? YES / NO

For children below 18 years of age, we give information about the study to parents or guardians. We will go over this information with you and you need to permit your child to participate in this study. We will give you a copy of this form for your records. The researcher above will issue a questionnaire to your child to get information on the uptake of myopia control strategies, the need is motivated by the need to address avoidable childhood vision impairment due to myopia because of its progression that arises due to the use of inappropriate myopia control strategies. The study is set to assess knowledge, attitude and factors influencing uptake of myopia control strategies among teenagers in Lurambi Constituency. This is ultimately with the view to make recommendations based on the expected findings from this research that will promote effective planning which will alleviate the burdens of vision impairment due to myopia in the average Kenyan child.

The activities that will include in this study will involve eye examinations of your child and their responses, derived from their perspective and/or judgment, to a series of questions. The exercise (the questions-written, and eye examinations) are purely for academic research purposes. Any information – views and personal details, they will give during this study, will be treated with utmost confidentiality. You or your child has the right at any point of the study, to not respond to any question they are not sure or comfortable with. You or they also have the right to withdraw them from the examination process or research protocol at any point you choose not to continue in the study.

Please note that your signing of this note means your full understanding and acceptance of your child to participate in this study. Also, note that your unwillingness to consent to your child's involvement in this study will be well respected and will in no way deny your child any privilege(s) that may likely come out of this study. Should you require further clarification on details of the above with regards to your child's involvement in this study, please

contact the optometry Head of the Department directly at 0724593853.

Thank you in anticipation of your kind consent for your child to participate in this study.

Yours Faithfully,

Participant's Legal Guardian signature

Consent Form for Eyecare Practitioners

TITLE: KNOWLEDGE, ATTITUDE AND FACTORS INFLUENCING UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS AND EYECARE PRACTIONERS OF LURAMBI CONSTITUENCY, IN KENYA.

RESEACHER: DELILAH SARAI**.**

INSTITUTION: MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY.

SUPERVISORS: 1. Prof. AJ Munsamy

2. Dr. C Wanjala

Introduction.

I would like to tell you about a study being conducted by the above-listed researchers. The purpose of this consent form is to give you the information you will need to help you decide whether you should participate in the study. Feel free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, the rights of you as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide if you want you to be in the study or not. This process is called 'informed consent'. Once you understand and agree to be in the study, I will request you to sign your name on this form. You should understand the general principles which apply to all participants in medical research: i) Your decision to participate is entirely voluntary ii) You may withdraw from the study at any time without necessarily giving a reason for his/her withdrawal iii) Refusal to participate in the research will not affect the services entitled to in this health facility or other facilities.

May I continue? YES / NO

We will go over this information with you and you need to permit yourself to

participate in this study. We will give you a copy of this form for your records. The researcher above will issue a questionnaire to you to get information on the uptake of myopia control strategies, the need is motivated by the need to address avoidable childhood vision impairment due to myopia because of its progression that arises due to the use of inappropriate myopia control strategies. The study is set to assess knowledge, attitude and factors influencing uptake of myopia control strategies among teenagers and ECPs in Lurambi Constituency. This is ultimately with the view to make recommendations based on the expected findings from this research that will promote effective planning which will alleviate the burdens of vision impairment due to myopia in the average Kenyan child.

The activities that will include in this study will involve giving your responses, derived from your perspective and/or judgment, to a series of questions. The exercise (the questions-written, and eye examinations) are purely for academic research purposes. Any information – views and personal details, they will give during this study, will be treated with utmost confidentiality. You have the right at any point of the study, to not respond to any question they are not sure or comfortable with. You or they also have the right to withdraw them from the examination process or research protocol at any point you choose not to continue in the study.

Please note that your signing of this note means your full understanding and acceptance of you to participate in this study. Also, note that your unwillingness to consent to involvement in this study will be well respected and will in no way deny your child any privilege(s) that may likely come out of this study. Should you require further clarification on details of the above with regards to your child's involvement in this study, please contact the optometry Head of the Department directly at 0724593853.

Thank you in anticipation of your kind consent to participate in this study.

Yours Faithfully,

Participant's Legal Guardian signature

Appendix II: Structured Questionnaires for the Study.

Questionnaire on Knowledge, Attitude and Factors of the User influencing the Uptake of Various Nearsightedness Management Approaches. (Appendix II a)

Instructions to the subject: Please read and answer the following questions about knowledge, attitude, and factors influencing the uptake of various near-sightedness management approaches.

Part One: Demographic Data

a. Age a.13 -15 year's □ 1 b. 16-18 years □ 2 c. 19 years 3

b. Gender Male □ 1 Female □ 2 Others □ 3

c. Type of the eye clinic of your visit?

Public □ Private □

d. School/class grade a. Primary □Junior secondary □ Upper Secondary □ Collage □

e. Refractive power of myopia?

a. .0.50-3.00 Ds □ b. 3.25 -6.00Ds □ c. < 6.00Ds □

Part Two: General Knowledge on Various Near-sightedness Management Approaches

Objective 1: Uptake of Near-sightedness Management Approaches

1. Are you using any nearsightedness management approach?

a) Yes □

b) No □

2. Which type of near-sightedness management approach are you using?

a) Single Vision eyeglasses

b) Segmented eyeglasses

c) Addition power eyeglasses

d) Segmented contact lenses

e) Contact lenses worn at night

f) Nearsightedness eyedrops and eyeglasses

g) Multi-segment eyeglasses

h) Nearsightedness eyedrops

i) None of the above

Objective 2: Knowledge on the uptake of nearsightedness management approaches

3. Have you ever heard about various near-sightedness management approaches?

a) Yes □

b) No □

4. Which type of myopia control strategies have you heard about?

a) Single vision spectacles and soft & hard CL □

b) Segmented spectacles and addition spectacles □

c) Segmented spectacles and atropine eyedrops □

d) Additional spectacles and gentamycin eyedrops□

5. How did you come to know about nearsightedness management approaches?

a) Self □

b) Through eye clinician □
c) Through the teacher □

d) Parent preference □

e) Media □

f) Through friends □

g) Through health awareness □

h) None of the above □

6. Why are you using/not using the nearsightedness management approach?

a) I don't know □

b) Improve vision □

c) Look intelligent □

d) Protect eyes from excessive light and injuries □

e) Slows nearsightedness from worsening □

Objective 3: Attitude in the Uptake of Nearsightedness Management Approaches Part Three: Attitude in the Uptake of Nearsightedness Management Approaches.

		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1.0	When I have an eye problem, I will tell my parents					
2.0	I think nearsightedness management are very important					

3.0	People who wear optical devices for nearsightedness control do not look smart					
4.0	People who wear optical devices for nearsightedness control do not look ugly					
5.0	Optical devices for control of nearsightedness does not make someone look handsome/beautiful					
6.0	I don't feel embarrassed when I wear an optical device for nearsightedness correction					
7.0	I feel my vision will not worsen when I use any nearsightedness management approach					
8.0	I feel using any nearsightedness management approach does not restrict me from doing					

	activities					
9.0	I feel young people should use any nearsightedness management approach to correct their vision					
10.0	I feel people who use nearsightedness management approaches take care of their eyes as well					
11.0	I feel those who use nearsightedness management approach must use them regularly					

Objective 4:

Part Four: Factors influencing Uptake of Various Nearsightedness Management Approaches.

		Strongly Disaagree	Disagree	Neutral	Agree	Strongly agree
1.0	Not having any/other					

	nearsight edness managem ent approach was the only option available					
2.0	Using nearsight edness managem ent approach or not is suitable for my eye condition					
3.0	I cannot afford any/other nearsight edness managem ent approach					
4.0	Eye doctor advised me on various near-sightedne ss managem ent approach					

5.0	Having this near-sightedness management approach or not choosing to have any has improved my vision					
6.0	My parent's disagreed on any/other methods of nearsightedness management Approach					
7.0	I am afraid of the complications that may arise while using any/ other nearsightedness					

	management approaches					
8.0	I don' like any/other methods of nearsightedness management approaches					
9.0	Using nearsightedness management approach or not is suitable for my eye condition					

Questionnaire on Strategies and Attitudes on the Management of Myopia among ECPs (Martínez-Pérez et al., 2022) **(Appendix II b)**

Instructions to the subject: Please answer the following questions below.

Section I: Demographic Information

a. Age (in years)

i. 18-30 □

ii. 31-40 □

iii. 41-50 □

iv. 51-60 □

v. 61 & above □

b. Gender

Male □1 Female □ 2

c. Which type of eye clinic are you working with?

Public □ Private □

d. Which Ophthalmic cadre are you practicing with? (Tick your highest credentials of the cadre that you are practicing with).

i. Ophthalmologist □

ii. Optometrist doctor □

iii. Optometrist □

iv. Optometrist technologist □

v. Ophthalmic clinical officer □

e. Years of experience as an eyecare practitioners?

i. Less than 5 years □

ii. 5-10 years □

iii. 11-20 years □

iv. More than 20 years □

Section II: Knowledge on the Uptake of Myopia Control Strategies

Objective 1: Uptake of myopia control strategies

1. Do you prescribe effective myopia control strategies? Yes □1 No □

2. Which type of myopia control strategies do you prescribe at your own practice? (multiple options could be selected)

i. Single Vision Spectacles □

ii. Bifocal spectacles □

iii. Progressive spectacles □

iv. peripheral defocus spectacles □

v. multifocal CL □
vi. Ortho-K CL □
vii. Combination treatment □
viii. Multi-segment spectacles □
ix. Low-dose atropine □
x. Medium-dose atropine □
xi. High-dose atropine □

Objective 2: Knowledge in the uptake of myopia control strategies

3. Are you aware of myopia control strategies?

i. Very aware □

ii. Somehow □

iii. Not aware □

4. Which is minimum patient age will you consider for the prescription of a myopia control method (assuming that the management skills and motivation of the child/parent are sufficient).

Mode of correction. Age

i. Single Vision Spectacles .....

ii. Bifocal spectacles .....

iii. Progressive spectacle .....

iv. peripheral defocus spectacles .....

v. multifocal CL .....

vi. Ortho-K CL .....

vii. Combination treatment .....

viii. Multi-segment spectacles lenses ……

ix. Low-dose atropine .....

x. Medium-dose atropine .....

xi. High-dose atropine .....

5. Which is minimum level of myopia that would be present to consider prescribing a myopia control method? (specified in 0.25D steps)

i. 0.50-0.75DS □

ii. 0.75-1.00DS □

iii. >1.00DS □

6. Which is minimum level of myopia progression (diopters/year) that would prompt you to specifically adopt a myopia control approach? (specified in 0.25D steps).

i. 0.50-0.75DS □

ii. 0.75-1.00DS □

iii. >1.00DS □

7. How frequent do you follow-up for myopic children who have adopted a myopia control method

i. 1-3 months □

ii. 4-6 months □

iii. 7-9 months □

iv. 10-12 months □

Section III: Attitude in the Uptake of Myopia Control Strategies

8. Which level are you concerned about the increase in the incidence of pediatric myopia in clinical practice?

i. Very often □
ii. Occasionally □

iii. Not important □

9. How active would you consider your clinical practice in myopia control?

i. Very often □

ii. Occasionally □

iii. Not important □

10. How frequent with which single-vision under-correction is being prescribed as a strategy to slow the progression of myopia?

i. Never □

ii. Sometimes □

iii. Always □

10. How has managing myopia changed patient loyalty, practice revenue and job satisfaction?

i. Much less □

ii. Less □

iii. No change □

iv. More or much more □

Section IV: Factors Influencing Uptake of Myopia Control Strategies

11. If you have only ever fitted single-vision spectacles/contact lenses to myopic patients, what had prevented you from prescribing alternative refractive correction methods? The options (multiple options could be selected)

Consist of:

a) They don't believe that these are any more effective □

b) The outcome is not predictable Safety concerns □

c) Cos to the patient makes them uneconomical □

d) Additional extra time required □

e) Inadequate information □

f) Knowledge Benefit/risk ratio □

g) Other factors □

12. Which selection criteria do you use for the decision to adopt a myopia control method? (Select more than one)

i. Refractive error □

ii. Age □

iii. Myopic parent (one) □

iv. Myopic parents (two) □

v. Axial length □

vi. Choroidal thickness □

vii. Choroidal thickness responsiveness to early treatment □

viii. Binocular vision status □

ix. AC/A ratio □

x. Patient pressure □

xi. Parent/guardian pressure □

13. Which criteria do you use for the selection of the first strategy to start myopia control in myopia control in a young myope? (Select more than one option)

i. There is only one method available to me □

ii. I am only comfortable using/trained to use one method □

iii. Age □

iv. Refractive error (non-cycloplegic) □

v. Cycloplegic refraction □

vi. Axial length □

vii. Choroidal thickness □

viii. Binocular vision status □

ix. Patient preference □

x. Parent/guardian preference □

xi. Other (please specify) □

14. What are the reasons for modifying a myopia control method/approach? (all relevant options could be selected) consist of:

i. I don't know □

ii. Progression of refractive error □

iii. Progression of axial length □

iv. Changes in choroidal thickness □

v. Availability of new treatment with greater efficacy □

vi. Poor compliance □

vii. Complications □

viii. Other (please specify) □

Appendix V: Eye clinics in Lurambi Constituency where the study population will be drawn.

Public Eye Clinic in Lurambi	Private Eye Clinics Lurambi
1. Kakamega County Referral Hospital Department.	1. Bliss Kakamega-Optical
-Eye Clinic Department. Kakamega-Eye Clinic.	2. Oasis Doctors Plaza
2. Academic Vision Center (AVC) Company.	3. Rayvince Optical Limited
	4. St. James Optical Kakamega
	5. Aga Khan Kakamega – Eye Clinic.
	6. Optica Kakamega.
	7. A & L Eye Clinic
	8. Kakamega Eye care Clinic
	9.West hill Eye Centre
	10. Pearl Optical.

Appendix VI: Approval Letter from Directorate of Postgraduate Studies

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
Fax: 056-30153
E-mail: directordps@mmust.ac.ke
Website: www.mmust.ac.ke

P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099 8th March 2024

Delilah Nangoi Sarai
HOV/G/01-70001/2021,
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms. Nangoi

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters Proposal entitled: ***"Kmowledge Attitude and Factors Influencing Uptake of Myopia Control Strategies Among Teenagers and Eyecare Practitioners In Lurambi Constituency, Kenya"*** and appointed the following as supervisors:

1. Prof. Alvin Jeffrey Munsany - UNIV. Of KwaZulu-Natal
2. Dr. Christine Wanjala - MMUST

You are required to submit through your supervisor(s) progress reports every three months to the Director Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Public Health, Biomedical Sciences and Technology Graduate Studies Committee and Chairman, Optometry and Vision Science Department. . Kindly adhere to research ethics consideration in conducting research

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY DIRECTORATE OF POSTGRADUATE STUDIES P.O. Box 190 - 50100, KAKAMEGA (K) Date:..... Sign:.....

Prof. Stephen O. Odebero, PhD, FIEEP
DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

Appendix VII: Approval Letter from Institutional Ethics Review Committee of MMUST

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY
Tel: 056-31375
Fax: 056-30153
E-mail: ierc@mmust.ac.ke
Website: www.mmust.ac.ke
P. O. Box 190,
50100.
Kakamega,
KENYA

Institutional Scientific and Ethics Review Committee (ISERC)

REF: MMU/COR: 40312 Vol 6(01) Date: March 15th, 2024

To: Ms. Delilah Nangoi Sarai

Dear Ms.

RE: KNOWLEDGE, ATTITUDE AND FACTORS INFLUENCING UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS AND EYECARE PRACTIONERS OF LURAMBI CONSTITUENCY, KENYA.

This is to inform you that the ***Masinde Muliro University of Science and Technology Institutional Scientific and Ethics Review Committee (MMUST-ISERC)*** has reviewed and approved your above research proposal. Your application approval number is **MMUST/ ISERC/021/2024.** The approval covers for the period ***March 15th, 2024 to March 15th, 2025.***
This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MMUST-ISERC.***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MMUST-ISERC*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MMUST-ISERC*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MMUST-ISERC.***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed

Yours Sincerely,

Prof. Gordon Nguka (PhD)
Chairperson, Institutional Scientific and Ethics Review Committee

Copy to:
- The Secretary, National Bio-Ethics Committee
- Vice Chancellor
- DVC (PR&I)

Appendix VIII: NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **915107**

Date of Issue: **03/April/2024**

RESEARCH LICENSE

This is to Certify that Ms.. DELILAH NANGOI SARAi of Masinde Muliro University of Science and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kakamega on the topic: KNOWLEDGE,ATTITUDES AND FACTORS INFLUENCING UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS AND EYE CARE PRACTITIONERS OF LURAMBI CONSTITUENCY,KENYA. for the period ending : 03/April/2025.

License No: **NACOSTI/P/24/34252**

915107

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

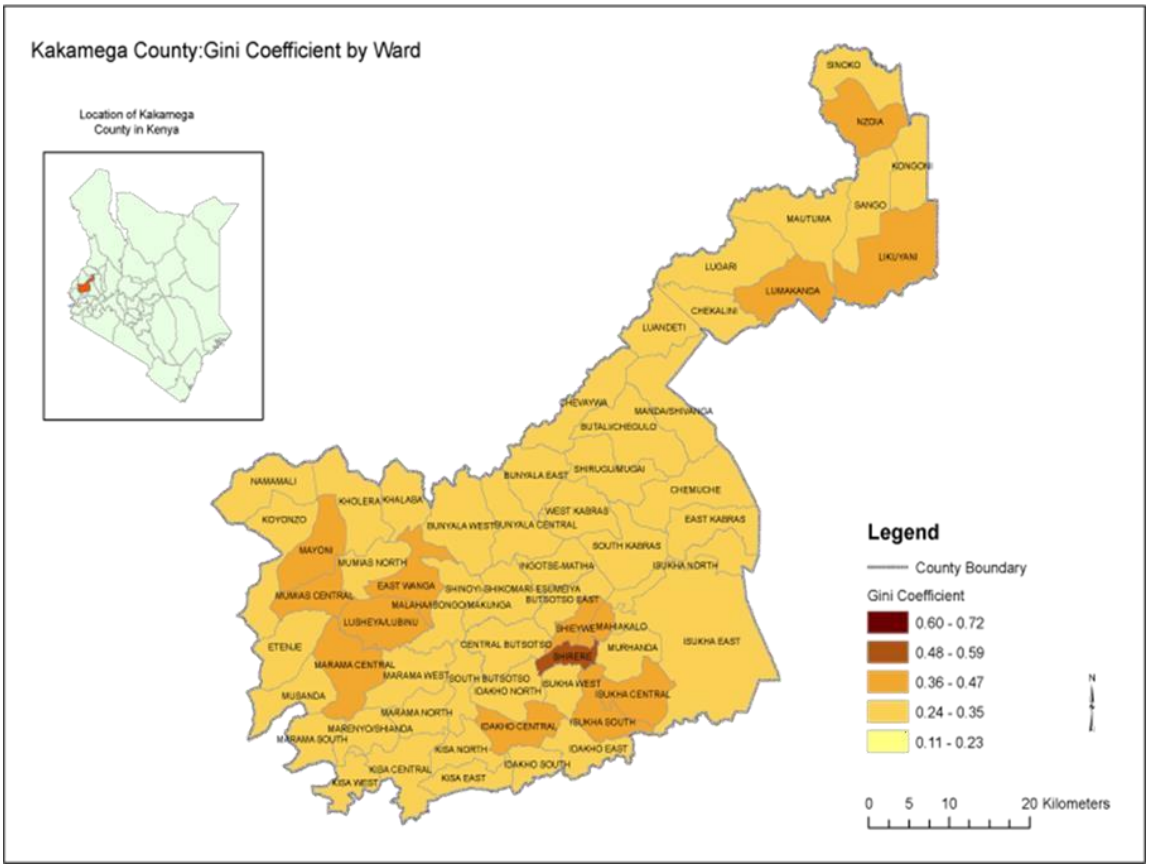
The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
    i. Endanger national security
    ii. Adversely affect the lives of Kenyans
    iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
    iv. Result in exploitation of intellectual property rights of communities in Kenya
    v. Adversely affect the environment
    vi. Adversely affect the rights of communities
    vii. Endanger public safety and national cohesion
    viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix IX: Map of Lurambi Constituency



Appendix VIII: DPS Thesis Guideline

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

MANUAL FOR GRADUATE PROPOSAL/THESIS WRITING

2012

TABLE OF CONTENTS

PROPOSAL WRITING FORMAT PRELIMINARIES

1. (i) TITLE PAGE

(a) Title to the work not more than 20 words.
(b) Name of candidates; first name, middle followed by a surname.
(c) Citation: A research proposal submitted in partial fulfillment for the requirements of the award of the respective degree of MMUST.

OR

Citation: A thesis submitted in partial fulfilment for the requirements of the award of the respective degree of MMUST.

(d) Month and year.

2. **ROMANS** (ii) Declaration:- Originality of work.

- Candidates name, registration number and signature.
- Supervisors approvals.

3. **ROMANS** (iii) Abstract: Not more than one page,
Single – spaced, one paragraph, font 12.

ROMANS (iv) - Table of contents.
- Bold chapter headings.

4. List of tables.
5. List of figures.
6. Accronyms and abbreviation.
7. The rest of the format that follows will be prescribed by the respective disciplines.

THESIS FORMAT

- In addition to proposal preliminaries, a thesis shall include a copyright page after declaration page, dedication (optional) after copyright; acknowledgement after dedication.

1.0 INTRODUCTION

This Masinde Muliro University of Science and Technology Graduate thesis manual identifies responsibilities of participant's viz, (students and supervisors) in the graduate training. It also presents information on matters on form (style) that are essential in preparation of a thesis. It is important that readers of this manual familiarize themselves with Masinde Muliro University of Science and Technology common rules and regulations for graduate degrees.

2.0 RESPONSIBILITIES

2.1 Masters and Doctoral Candidates

Candidates are responsible for:-

i) Maintaining regular consultation with Supervisors.
ii) Presenting progress reports to the relevant Departments as stipulated in the University regulations.
iii) Securing, organizing and presenting content professionally and accurately.
iv) Adhering to correct or presenting quotations, footnotes, bibliographical items, tables, and other illustrative materials accurately.
v) Supplying thesis materials according to the requirements prescribed in this manual.
vi) Checking thesis for errors.
vii) Presenting intention to submit the thesis to the relevant Department as stipulated in the University Regulations.
viii) Defending all aspects of the thesis during oral examination.
ix) Making corrections as recommended by the Board of Examiners.
x) Ensuring that the required number of copies of thesis and all original and dully signed Certificate of Correction (Appendix 1) are submitted to SGS.

2.2 University Supervisor

The University Supervisor's responsibilities are:

i) To serve as resource person.
ii) To enhance the quality of a student's research work.
iii) To offer advice on improvements on thesis content and form.
iv) To ensure that written reports on the progress of a student's studies are submitted as required by the University regulation.
v) To ensure that a student presents Seminars as required by the University regulations.
vi) Student attends seminars and conferences

By appending his or her signature on the appropriate page of thesis, a Super- visor is certifying that the thesis represents the work of the candidate that was carried out under his/her Supervision.

3.0 PLAGIARISM

A failure to acknowledge one's source of literature constitutes plagiarism. Plagiarism can arise from:

a) Not putting words copied verbatim from another author's work in quotation marks.
b) Piecing together several sentences, changing a few words in paragraph or paraphrasing without citation.

4.0 STYLE

Style deals with matters of form in preparing a manuscript with the purpose of ensuring consistency, precision and clarity.

Scholarly publication style varies among disciplines. Because of this, departments/faculties are required to declare the style to be used in their areas of disciplines. Below are general guidelines.

4.1 Typing of Thesis

A thesis must be type-written or printed on an 4A size, 80 gram bond paper. Any deviation from this standard paper size must be approved by the Board of the School of Graduate School. Computer printed material must be of good quality. There must be consistency in the typeface. The thesis shall be typed with double spacing.

4.2 Margination

There must be a 40mm margin on the left hand side and 25mm margin on the right hand side of the paper. Margins must be 25mm wide from the top and 25mm from the bottom of the page.

4.3 Pagination

Pages shall be numbered consecutively in Arabic numerals, starting with the first page of text and the number shall appear in the centre of the bottom margin of the page. Preliminary pages such as table of contents, list of tables and figures that precede the first page of text shall be numbered using small Roman numbers.

4.4 Chapter and Major Sections

Chapters and major sections (for example Introduction, Literature review, Ma- terials and Methods, Results, Discussion etc.) should each begin on a new page. All sub-sections may begin immediately after proceeding materials, ex- cept that sub-section heading should not be placed at the bottom of a page unless it is followed by two lines of text. Headings in a thesis must be internally consistent.

Partly filled pages of text are not permitted except at the end of a chapter or where there is not sufficient room to place four or five lines of text either above or below a table.

4.5 Title Page

The first page bears the title of the Thesis in Capital letters with the full names of the candidate in small bold letters below.

The legend "A thesis/dissertation submitted in partial fulfillment of the requirements for the degree of (Insert the name of the degree) of Masinde Muliro University of Science and Technology" shall appear in the middle of the page.

The date of submission shall appear below in the form of month and year.

4.6 Declaration and Certification page

The section must contain:

a) A signed and dated declaration by the candidate with the following statement: "This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award."
b) A signed and dated certification by the University Supervisors with the following statement "The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro University of Science and Technology a the- sis/dissertation entitled…….

4.7 Copyright Page

This thesis/dissertation is copyright materials protected under the Berne Con- vection, the copyright Act 1999 and other international and national enactments in that behalf, on intellectual property. It may not be reproduced by any means in full or in part except for short extracts in fair dealing so for research or private study, critical scholarly review or discourse with acknowledgment, with written permission of the Dean School of Graduate Studies on behalf of both the author and Masinde Muliro University of Science and Technology.

4.8 Dedication

A dedication statement not exceeding 25 words may follow the declaration be- ginning on a separate page. Dedication should as much as possible be limited to one person or one party or else it looses its significance and value.

4.9 Acknowledgments

Acknowledgement not exceeding 150 words should follow dedication, begin- ning on a separate page, with the surname and initials of the author on the left- hand corner below it.

4.10 Abstract

An abstract of the thesis not exceeding one page should follow the acknowledgment, beginning on a new page.

4.11 Table of contents

A table comprising preliminaries, chapters, bibliography/references and appendices of contents should follow the abstract, beginning on a new page. The table of contents should let a reader know quickly and clearly how a thesis is organized. There must be consistency in the use of headings and sub-headings in both the tables of contents and the text.

4.12 List of Tables

A list of tables should follow the table of contents, beginning on a separate page.

4.13 List of Figures

A list of figures should be on a separate page immediately after the list of tables.

4.14 List of Abbreviations and Acronyms

A list of abbreviations and acronyms should immediately follow the list of figures on a separate page.

4.15 The Thesis/Dissertation

A complete master or doctoral thesis should conform to the following items:

- Title page
- Declaration page
- Copyright page
- Certification page
- Dedication page
- Acknowledgement
- Abstract
- Table of contents
- List of tables
- List of figures
- List of abbreviations and acronyms
- Main chapter i.e. 1,2, 3……..

- Bibliography/reference
- Appendices/annexes

Figures, numbers and captions should appear below figures

A table that is oversized may be divided so that a portion appears on two pages which face each other. If this method is used, the entire title and footnotes, if any, appear on the left-hand side of a table.

Whenever possible, photographs should be printed directly on A4 photographic paper. However, in special cases, photographs may be mounted on 100% bond paper by use of double adhesive mounting paper. A lamination process may also be used.

4.16 References

Most style manuals describe how literature is to be referenced and bibliographies constructed. Minimum requisites are that referencing system and bibliographies/references be consistent throughout, be clear and fully agree with each other both in the text and list of references. Literature must be cited by author and dated or by number in the text, and a list of references must appear at the end of the thesis. Departments and Faculties may vary in the way they cite literature provided the citing is in accordance with accepted international conventions described in any one of the manuals listed in appendix 2. Departments, Faculties, however, are required to declare the referencing systems to be in their areas of discipline.

5.0 TABLES, FIGURES AND PLATES

Tables, figures and plates may be included within the text or appear on separate pages. If on separate pages, however, they should be placed near the text which refers to them.

Each table, figure and plate shall have a full caption. Tables, figures and plates should be numbered in sequence and should be cited by a number in the text. A table, figure and plate must fit within the margins previously mentioned.

6.0 THESIS/DISSERTATION SUBMISSION

i) At least three months before a thesis is submitted, a candidate shall give notice to the Dean, School of Graduate School (SGS) through the Supervisor the relevant DGSC and FGSC on five copies of the prescribed form Ref. MMUST/SGS/BPS/ADM/2 (Appendix 3) obtainable from SGS of his/her intention to submit. Copies of such a notice must be given to the Chairman of Department and Dean of the Faculty.

ii) The notice must include the title of the thesis, an abstract not exceeding 500 words of the work competed, and the intended date of submitting the thesis.

iii) Six copies of loosely bound theses and a soft copy, duly signed by the candidate and all Supervisors, shall be submitted to the Dean, SGS through the Chairman of the DGSC

and through the Chairman of FGSC along with a forwarding letter.

7.0 THESIS/DISSERTATION EXAMINATION.

The examination involves evaluation of thesis to determine whether it:

i) Conforms in presentation to the regulations for thesis writing of Masinde Muliro University of Science and Technology.
ii) Reflects evidence of the candidate's capacity for original thought and understanding of the subject.
iii) Is adequate in form and content.
iv) Makes a distinct contribution to knowledge.

8.0 THESIS PRODUCTION

The objectives in production of the original master and copies of a thesis is to ensure:-

a) Permanence
b) Readability of format and content
c) Microfilm reprints
d) Legibility of print
e) Uniformity

Therefore, careful attention must be given to materials and methods used to produce the original master and copies of the thesis.

Final copies of the thesis shall be bound in high quality Blue (university colour) cover for a master's degree and blue for a doctoral degree with appropriate lettering as laid down in the common regulations for higher degrees. Lettering on the thesis spine should have the candidate's surname and initials. The first letter of the surname commences 4cm from the top of the thesis. The name of the degree should appear in the middle of the spine. There should be a 5mm space between the year and the bottom end of the thesis. Six copies shall be produced.

9.0 SEMINARS

i) A master's candidate shall be required to give at least one Seminar in addition to the defense of research proposal in the relevant department/faculty before submission of a thesis for examination.
ii) Doctoral candidate shall be required to give at least two Seminars in addition to the defense of research proposal in the relevant department/faculty before submission of a thesis for examination.
iii) Successful candidates will be expected to present their research findings at a conference organized by MMUST at a convenient date.

APPENDIX 2: SOME OF THE RECOMMENDED STYLE MANUALS:

1. Mla Handbook for writers of Research papers, Theses and Dissertations.
2. Council of Biology Editors Style Manual.
3. Style Manual for ASA, CSSA, SSSA.
4. Turabian A. Manual for writers of Term papers, Theses and Dissertations, 5th Edition.
5. American chemical Society Handbook for Authors.
6. American Psychological Association Manual.
7. Chicago A. Manual of Style.

Submission and Examination of Thesis

1. At least twelve weeks before the end of the fourth semester, acandidate shall give a written notice of intent to submit a thesis to the Dean School of Graduate Studies through the Supervisor(s) and Head of department. The notice should be copied to the Dean/Director of the Faculty/School/Institute and to the chairmen of the Departmental and Faculty Graduate Studies committees. The notice should include a signed Abstract not exceeding 400 words and which has been countersigned and dated by the Super- visor (s).

2. Within four weeks after the notice of intent to submit a thesis has been issued, the respective Chairman for the Departmental Graduate Studies Committee shall recommended to the Dean School of Graduate Studies through the respective FGSC, one Eternal Examiner, two Internal Examiners and two Faculty Representatives for the can didate's panel of Examiners. The CV of Examiners who are not staff of Masinde Muliro University of Science & Technology shall also be submitted for consideration by the Board, SGS, if the Examiners are being appointed for the first time. The Senate shall, on the recommendation of the panel of SGS, appoint in respect of each candidate presenting a thesis, a panel of Examiners for oral examination, consisting of:
   a) The Dean SGS, or Representative
   b) One External Examiner
   c) Two Internal Examiners, at least one of whom should be from the relevant department,
   d) Candidate's Supervisor (s),
   e) Two Faculty Representatives

3. The faculty Representatives shall normally be from Masinde Muliro University of Science and Technology but preferably not from the same department as the candidate. They shall not be required to read the thesis although they shall be access to the thesis and the written assessment reports. The Faculty Representatives shall assess the candidate only during Oral Defense.

4. Each candidate shall submit six spiral bound copies of his/her thesis to the Dean SGS. The thesis must be prepared according to the format approved by Senate and must be signed by the student and the Supervisor (s) and bear the date of submission.
5. Copies of the thesis shall be distributed to the Internal and External Examiners and the Supervisor (s). The two Internal Examiners and the External Examiner shall be required to assess the thesis and submit detailed reports to the Dean SGS and copies to the Registrar Academic Affairs, within four weeks of receipt of the thesis. An honorarium shall be paid to the Examiners subject to the submission of satisfactory reports on time.

6. Each examiner shall indicate within hi/her detailed report:
   a) Whether or not the thesis is adequate in form and content:
   b) Whether or not the thesis reflects an adequate understanding of the subject, and in consequences;
   c) Whether or not the thesis needs revision or corrections; and
   d) The mark to be assigned to the thesis

7. The Dean SGS, in consultation with the Chairman of the respective Departmental G.S Committee shall appoint a new Examiner when an Examiner's report is delayed for more than one month. A new Examiner shall be appointed.

8. After the receipt of all the Examiner's reports, the Director, IGSRE shall set a date for the Oral Defense. Such a date shall normally be within three weeks of the date of receipt of the last report. The External Examiner's for Masters. Candidate shall not be required to attend the Oral Defense, but the External Examiner's report and grade shall be given due attention during the defense.

9. The oral examination shall be open to the public. The public will be allowed to ask questions but these may or may not contribute to the assessment of the candidate's performance. The duration of the Oral Defense shall be a maximum of 2 hours. A candidate will be given 20 minutes to present his/her work after which there will be a questions and answers session. Assessment shall e conducted as follows:

   a) Each member of the board, with the exception of the Supervisors, shall be required to assign a grade not exceeding 20% to the Oral Defense. The mean of all the scores shall be the final grade for that defense, and shall be designed mark Y.
   b) The Chairman of the Board of Examiners shall calculate the mean score from the three examiner's scripts designate it as mark X. The overall Grade for the thesis shall then be calculated from the following formula: Thesis Mark = (08 X + Y) %
   c) A candidate must pass both the Oral Defense and the Written Thesis to be declared pass overall. The pass mark is 50%.
   d) If a candidate is failed by the External Examiner, the External Examiner may be invited to the defense.

10. After the completion of the Oral Defense, and taking into account items 10.5 (g) and (j), the Board of Examiners shall decide:

a) Whether the candidate defended the thesis adequately and the whether the candidate should be declared pass outright, thus assigning the grade to the thesis, and recommending the award of the degree subject to the candidate fulfilling other requirements in respect of course work.
b) Whether the thesis needs minor revision and/or corrections over the above the recommendations contained in the Examiners' Reports, thus assigning the grade to the thesis, and recommending submission of the final revised thesis within one month, duly certified by the Supervisors.
c) Whether the thesis needs major revision and corrections, and recommending re-submission of the thesis within three months for fresh assessment by on of the Internal Examiners. Should the candidate still fail at this stage, the candidate must submit a revised thesis within six months for fresh assessment by all the three Examiners and appear for a second defense thereafter
d) Whether the thesis needs a compelete overhaul, including collection of more data and/or change of methodology, and recommending re-submission within nine moths for fresh assessment by all the three Examiners and a second defense thereafter.
e) Whether the thesis is unacceptable for the award of a Masters degree of Masinde Muliro University of Science & Technology, and declaring the candidate having failed outright.

11. A thesis cannot be defended more than twice.

12. A candidate who fails overall after the Oral defense shall not be awarded the Masters degree

13 A candidate who fails according to item 10.5 k) (v) may be considered for the award of a Graduate Diploma as long as the candidate meets the necessary requirements for such an award, otherwise the candidate shall be discontinued.