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ORIGINAL ARTICLE

MAGNITUDE OF MYOPIA AND FACTORS INFLUENCING THE UPTAKE OF MYOPIA CONTROL STRATEGIES AMONG TEENAGERS IN LURAMBI CONSTITUENCY, KENYA.

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Keywords

Control
Strategies,
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Background: The rising prevalence of myopia among teenagers is concerning due to its long-term health risks. While effective myopia control strategies (MCS) are available, the relationship between myopia severity and uptake of these strategies is unclear. This study aimed to assess the magnitude of myopia and factors influencing the uptake of MCS among teenagers in Lurambi Constituency, Kenya.

Methods: This cross-sectional study was carried out in all eye clinics within Lurambi Constituency, Kenya, involving 115 teenagers. The study was conducted from April to June 2024. The Eye clinics were selected purposively, and within each clinic, all teenagers were sampled via a census. Data were collected through a self-administered modified questionnaire and analyzed using SPSS version 27, with descriptive statistics presented as proportions and percentages, and inferential statistics using logistic regression. Ethical approval was sorted using prior to data collection (MMUST/COR: 40312 Vol 6(01)).

Results: Among 115 teenagers, the majority (53.0%) were female; most (74.0%) were recruited from public eye clinics; and 44.0% were between 15 and 18 years of age. About 79.1% of teenagers had mild myopia, and overall, 16.5% (n=19) adopted MCS, with atropine eye drops at 31.6% and multifocal contact lenses at 10.5%. Factors influencing MCS uptake include availability (67.8%), suitability (58.3%), cost (73.0%), eye doctor preference (80.0%), and effectiveness (71.3%). An increase in cost reduced the likelihood of MCS adoption by 36.7%.

Conclusion: Most teenagers had mild myopia, and MCS uptake remains low because of limited knowledge. Further research is needed on the factors underlying myopia control in Kenya.

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INTRODUCTION

The prevalence of myopia, particularly among teenagers, has been increasing globally, raising significant concerns regarding its long-term health implications.¹ Myopia, especially high myopia, is associated with several serious, vision-threatening conditions, including cataracts, retinal detachment, myopic macular degeneration (MMD), glaucoma, and optic neuropathy.² These conditions can lead to irreversible vision impairment, imposing a substantial burden on both individuals and healthcare systems.³ As myopia progresses, individuals may require additional support in daily activities, further straining healthcare systems and decreasing quality of life. The World Health Organization recognizes myopia as a significant public health challenge due to its potential to cause severe visual impairment.⁴ This highlights the critical need for preventive measures and timely interventions to curb myopia progression and reduce the associated burden on healthcare systems. According to global estimates, around 2.6 billion people worldwide are affected by myopia. The prevalence varies by region, with higher rates observed in Asian populations and lower rates among African Americans.⁶⁻⁷ Environmental factors, such as increased near work (e.g., excessive digital device use) and reduced outdoor activities, play a key role in the development of myopia, alongside genetic predisposition.⁸ Early-onset myopia is a major predictor of progressive myopia and its associated complications.⁹ To mitigate myopia progression, various MCS have been developed, including multifocal contact lenses (CLs), low-dose atropine, and orthokeratology, all of which have proven effective in slowing the progression of myopia.¹⁰ On the other hand, traditional single-vision (SV) glasses, despite their widespread use, are less effective at managing myopia progression.¹¹ However, the uptake of these control strategies, particularly among teenagers, remains poorly understood. As the severity of myopia increases, early intervention becomes critical in preventing irreversible damage and severe vision impairment. In many low- to middle-income countries, SV spectacles remain the most widely used method for myopia correction due to their affordability, availability, and convenience¹². However, these spectacles are ineffective in preventing myopia progression.¹³ Despite the availability for more effective interventions like CLs and atropine, uptake of these strategies is low, with cost being a significant barrier, particularly in a country where access to basic healthcare remains a challenge.¹⁴ Various factors influence the uptake of

MCS, including cost, the effectiveness of the intervention, parental awareness, misconceptions about myopia and its treatment, and the knowledge and skills of eye care practitioners.¹⁵⁻¹⁶ Studies indicate that parental knowledge and resistance to spectacle use, as well as the availability of free screening and optical devices, play crucial roles in shaping the adoption of MCS.¹⁵ However, misconceptions such as the belief that wearing spectacles causes myopia to worsen or that glasses are harmful for children with early myopia can hinder the adoption of these strategies.¹⁷ Research Findings from African countries such as Nigeria and South Africa highlight affordability, material quality, convenience, and spectacles' effectiveness as significant determinants of uptake.¹⁸⁻¹⁹ In Kenya, however, no studies have examined the factors influencing the uptake of MCS, creating a knowledge gap in addressing this emerging health crisis. Furthermore, the influence of these factors on MCS uptake remains unclear, particularly in the context of the growing prevalence of myopia in the region. The rising prevalence of myopia, driven by environmental and lifestyle changes, underscores the urgent need for research into the factors influencing the uptake of MCS. This is particularly critical in countries like Kenya, where access to myopia control options is limited by economic constraints and limited awareness. Understanding the relationship between myopia severity and willingness to adopt preventive measures is vital for developing targeted, context-specific interventions to reduce the long-term health burden of myopia. Therefore, this study aimed to assess the magnitude of myopia and factors influencing the uptake of MCS among teenagers in Lurambi Constituency, Kenya.

METHODS

The study was conducted across all eye clinics within the Lurambi Constituency, Kakamega County, Kenya. Lurambi Constituency comprises 10 private eye clinics and 2 public eye clinics.

Study Design and Study Population

This study used a cross-sectional design. The study focused on teenagers aged 13–19 years diagnosed with myopia. Participants included in the study had myopia of ≤ -0.50 Ds. Teenagers with pathological eye conditions, such as cataracts, as well as those whose parents or guardians did not consent to participate, were excluded. The sample size was determined using Cochran's formula.²⁰

The sample size for this study was determined using the formula:

Table 1: Demographic Data for Teenagers Uptake of MCS among Teenagers of Lurambi Constituency, Kenya,

Category	Total n (%)	Uptake n (%)	Non-Uptake 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)

$$n = \frac{Z^2 PQ}{d^2} / (1 + \frac{Z^2 PQ}{Nd^2})$$

where Z represents the standard normal deviate at the 95% confidence level (1.96), d is the clinically acceptable margin of error set at 5%, P is the prevalence of secondary school-going adolescents in Lurambi Constituency (7.5%),²¹ $Q = 1 - P$, and N is the total population of adolescents in Lurambi Constituency, estimated at 1,473.²² Therefore, the sample size was 101. Given the possibility of dropouts and unforeseen circumstances, a 10 percent (10 teenagers) non-response rate was added to the sample, bringing the maximum sample size to 111.

Data collection

Data Collection was carried out across all eye clinics in the constituency using a purposive sampling technique. Due to the lack of clear records of myopic teenagers at some clinics, a census approach was adopted to include all teenagers attending these clinics with myopia. Teenagers underwent cycloplegic refraction conducted by ECPs from the respective clinics in Lurambi Constituency, followed by the administration of a structured, modified questionnaire,¹⁹ was used to

gather data on participants' factors influencing the uptake of MCS. Prior to data collection, the questionnaire was piloted and revised as needed. It comprised closed-ended questions and demonstrated good reliability (Cronbach's Alpha = 0.7).

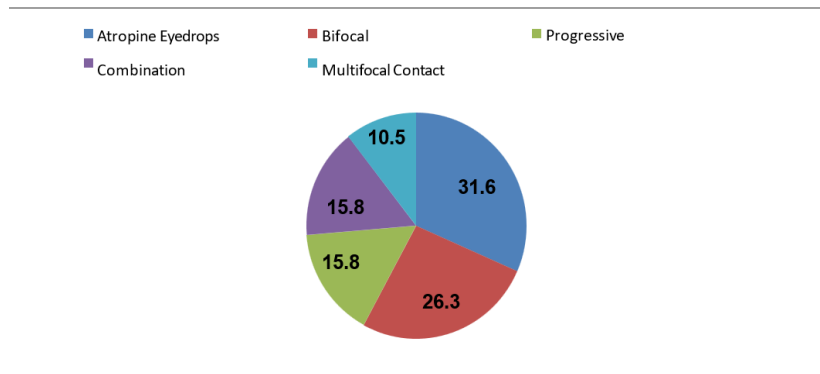
Data Analysis

The collected data were entered into an MS Excel 2022 spreadsheet and reviewed by the principal researcher to ensure accuracy and completeness. The finalized data was then exported to SPSS version 27 for analysis. Descriptive statistics were presented in frequencies and percentages, while inferential statistics were conducted using logistic regression tests, with statistical significance set at $p < 0.05$.

Questionnaire Score Calculation

The evaluation criteria for MCS were 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 was allocated zero points. Section four of the teenagers' questionnaire consisted of eight questions on factors influencing the uptake of MCS. Each question represented a factor; therefore, the maxi-

Figure 1. Uptake of MCS among Teenagers of Lurambi Constituency, Kenya



mum points per question were 4. The factor score was calculated by the formula: Factor Score = (Total Points / Maximum Points) × 100. Thereafter, a factor scores of 50-100 was considered a factor, whereas 0-49 was considered a non-factor.

ETHICAL CONSIDERATIONS

The study adhered to ethical standards as outlined in the Declaration of Helsinki. Prior to participation, each respondent signed an informed consent form, and assent was also obtained from participants regardless of age. For participants under 18, written consent was obtained from their legal guardians, who were provided with a

simplified consent form in English. The study was approved by the National Commission for Science, Technology, and Innovation (NACOSTI P/24/34252) and received ethical clearance from the Masinde Muliro University Ethics Review Committee (MMUST/COR: 40312 Vol 6(01)).

RESULTS

The study involved 115 teenagers. There was a female preponderance (53.0%) and about three-quarters (85.7%) were recruited from the government-owned eye clinics. Age-wise the majority (44.0%) were between 15 and 18 years old. The mean age of the sample was 15.8 years, with a standard deviation of 5.6 years.

Table 2: Magnitude of Myopia in Relation to Uptake of Various MCS among Teenagers of Lurambi Constituency, Kenya.

Myopia Control Strategies	Level of Myopia	Uptake of MCS (19) n (%)
Bifocal Spectacles	0.50-3.00 Ds	3 (15.8)
	3.25-6.00 Ds	0 (0.0)
	> 6.00 Ds	2 (10.5)
Progressive Spectacles	0.50-3.00 Ds	0 (0.0)
	3.25-6.00 Ds	1 (5.3)
	> 6.00 Ds	2 (10.5)
Multifocal CL	0.50-3.00 Ds	2 (10.5)
	3.25-6.00 Ds	0 (0.0)
	> 6.00 Ds	0 (0.0)
Ortho-K	0.50-3.00 Ds	0 (0)
	3.25-6.00 Ds	0 (0)
	> 6.00 Ds	0 (0)
Combination Treatment	0.50-3.00 Ds	3 (15.8)
	3.25-6.00 Ds	0 (0)
	> 6.00 Ds	0 (0)
Multifocal Spectacles	0.50-3.00 Ds	0 (0)
	3.25-6.00 Ds	0 (0)
	> 6.00 Ds	0 (0)
Atropine Eyedrops	0.50-3.00 Ds	5 (26.3)
	3.25-6.00 Ds	0 (0)
	> 6.00 Ds	1 (5.3)

Table 1 shows the demographic profile of teenagers in Lurambi Constituency, Kenya. Regarding refractive errors, a substantial proportion (79.1%) had mild myopia of 0.50 to -3.00Ds. Among the 115 teenagers who participated in the study, 19 (16.5%) reported using MCS. Figure 1 shows specific MCS among teenagers. Of those who had uptake of MCS (n=19), atropine eye drops were the most adopted strategy at 31.6% and multifocal contact lenses was least adopted at 10.5%. Ortho-K contact lenses and multi-segment spectacles had no uptake. Interestingly, among the (n=96) participants who had not adopted any MCS, 46.9 % were using single vision spectacles, while 53.1% reported no uptake of a MCS or a myopia correction method. Among teenagers who had adopted MCS (n =19), those with mild myopia of (-0.50 to -3.00 Ds) most used atropine eye drops 26.3%. For moderate myopia (-3.00 to -6.00 Ds), only one participant (5.3%) adopted progressive addition lenses as MCS. Among participants with severe myopia (-6.00 D or worse), 10.5% used bifocal spectacles and 10.5% used progressive spectacles. Table 2 shows the magnitude of Myopia in relation to the uptake of various MCS among teenagers of Lurambi Constituency, Kenya. The findings in Table 3 indicate that, among 115 teenagers, various factors influence the uptake of MCS. Among these participants, eye doctor preference was the most influential factor at 80%, followed by cost at 73.0%. Among those who adopted MCS, a larger proportion (84.2%) reported that cost was a key influencing factor. A logistic regression was conducted to determine the relationship between identified factors influencing the uptake of MCS and the actual adoption of these strategies. Only three factors showed a significant association: an increase in cost decreased the odds of uptake of MCS by 36.7%. Moreover, the availability of MCS and the risk of myopia progression were associated with the uptake of MCS by 38% and 12%, respectively. Table 4 shows all relationships between the identified factors and uptake of MCS among teenagers.

DISCUSSION

Most teenagers presented with mild myopia and uptake of MCS was notably low. Among those who adopted MCS, atropine eye drops were the most utilized. Among non-adopters, SV spectacles were the most frequently used form of vision correction. Eye doctor preference emerged as the most influential factor in MCS uptake, followed by cost. However, logistic regression analysis identified

cost, MCS availability, and the risk of myopia progression as factors significantly associated with uptake. Mild myopia (-0.50 to -3.00 Ds) was the most prevalent. These findings align with global trends in the distribution of myopia severity, in which mild myopia accounts for most cases.¹³ Despite its classification as mild, myopia poses a significant risk of progression, potentially leading to severe visual impairment. Mild cases are also a concern because they can progress to more severe refractive error, underscoring the need for early and effective interventions.²⁴ This study is similar to a study among medical students in Udaipur, India, which found that mild myopia was prevalent at 61.78%.²⁵ This can be explained by the age-related onset and progression of myopia.²⁶ In both settings, the study populations primarily comprised adolescents and young adults. Myopia commonly develops during childhood or early adolescence and is usually mild in its early stages before progressing.²⁷ Consequently, many individuals are identified at an early stage, prior to the development of moderate or high myopia.²⁸ The overall uptake of MCS among teenagers in this study was 16.5%. Atropine eye drops were the most used MCS, while Ortho-K and multi-segment lenses were not adopted. These rates were notably higher than those reported by a study encompassing 19 countries from Europe, six from Asia, four from the USA, and two from the Australian continent, among children aged 17 years and younger, which reported an uptake of soft and rigid contact lenses at 2.3%.²⁹ In Eritrea, a study reported a 22.2% uptake of traditional SV spectacles among children aged 15-20 years, while in Kenya, another study reported a 7.6% uptake among teenagers aged 14-20 years in Nairobi County.^{30, 31} However, these studies focus solely on the uptake of SV spectacles, a myopia correction method rather than on MCS. Among the (n=19) teenagers who adopted MCS, atropine eye drops were the most frequently selected intervention among those with mild myopia (-0.50 and -3.00 Ds). Multifocal contact lenses have demonstrated efficacy in controlling myopia progression, with reported effectiveness ranging from 25% to 72%.³² Similarly, orthokeratology (Ortho-K) lenses have been shown to reduce myopia progression by approximately 44%.³³ Despite these documented benefits, the adoption of advanced interventions such as multi-segment spectacles and Ortho-K lenses remains notably absent across various levels of myopia in Lurambi Constituency, Kenya.

Table 3. Factors influencing Uptake of MCS among Teenagers of Lurambi Constituency, Kenya.

Factors influencing Uptake of MCS	Total number of participant n (%) n =115	Uptake of MCS n (%) n =19	Non-Uptake of MCS n (%) n=96
Availability of myopia control strategies			
Factor	78 (67.8)	12 (63.1)	66 (68.7)
Non-factor	37 (32.2)	7 (36.9)	30 (31.3)
Suitability of the strategies			
Factor	67 (58.3)	14 (73.6)	52 (54.1)
Non-factor	48 (41.7)	5 (26.4)	44 (45.9)
Cost			
Factor	84 (73.0)	16 (84.2)	67 (69.8)
Non-factor	31 (27.0)	3 (15.8)	29 (30.2)
Eye doctor preference			
Factor	92 (80.0)	15 (78.9)	76 (79.2)
Non-factor	23 (20.0)	4 (21.1)	20 (20.8)
Effectiveness of the strategy			
Factor	82 (71.3)	12 (63.1)	74 (72.9)
Non-factor	33 (67.0)	7 (36.9)	26 (27.1)
Parent preference			
Factor	82 (71.3)	7 (36.8)	44 (45.8)
Non-factor	33 (28.7)	12 (63.1)	52 (54.2)
Risk of myopia progression			
Factor	47 (40.9)	14 (73.7)	52 (54.2)
Non-factor	68 (59.1)	5 (26.3)	44 (45.8)

This lack of uptake suggests limited awareness or accessibility to these advanced MCS. Furthermore, orthokeratology, though effective, faces several challenges that may limit its widespread adoption. These include high costs, the requirement for specialized eye care services, strict adherence to prescribed protocols, the need for expertise in fitting contact lenses, and the risk of infective keratitis.³⁴ Low-dose atropine (0.01–0.05%) is the most widely practiced strategy globally due to its high efficacy.³⁵ Pharmacological treatments have seen limited but notable adoption, particularly atropine eye drops. The restricted use of atropine, especially among individuals with higher degrees of myopia, may be linked to concerns about rebound effects at higher doses, limited availability, or insufficient information on its effectiveness in slowing myopia progression.³⁶ ECPs' preferences were among the most influential factors in the uptake of MCS, which may be attributed to ECPs' key role in its adoption.³⁷ 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 MCS among teenagers. Their ability to offer detailed advice tailored to individuals' specific needs and eye health status

ensures 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 MCS. The effectiveness and availability of the strategy influenced the uptake of MCS. These identified factors are consistent with the findings of a systematic review study conducted across Asia, Australia, Europe, North America, and South America.³⁸ The 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. The cost of adopting various MCS in Africa remains a major barrier. This study found that cost influenced the uptake of various MCS. As in other studies in South Africa, Nigeria, Nakuru, and Kenya, the cost was found to be a significant barrier.^{18,19,31} 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 MCS.

Table 3b. Factors influencing Uptake of MCS among Teenagers of Lurambi Constituency, Kenya.

Factors influencing Uptake of MCS	Total number of participant n (%)	Uptake of MCS n (%)	Non-Uptake of MCS n (%)
	n =115	n (%) n =19	n=96
Non-factor	68 (59.1)	5 (26.3)	44 (45.8)
Patient preference			
Factor	55 (47.8)	10 (52.6)	44 (45.8)
Non-factor	60 (52.2)	9 (47.4)	52 (54.2)

Contrary to other studies that found the uptake of MCS to have been influenced by the risk of myopia progression among teenagers in the UK, Spain, East Asia, the Middle East, India, Latin America, China, and Korea.³⁹⁻⁴⁰ In these areas, high rates of myopia progression among adolescents have heightened awareness and concern among parents, healthcare providers, and policymakers. In East Asia and China, myopia prevalence is particularly high.⁴¹ Cost, availability of MCS, and risk of myopia progression as factors significantly associated with uptake of 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 MCS can prevent more severe and costly eye problems in the future.⁴² 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 from healthcare programs may 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,⁴³ plays a crucial role in increasing the likelihood of adopting MCS among teenagers in Lurambi Constituency.⁴³

CONCLUSION

Most teenagers had mild myopia. The adoption of effective MCS remains low regardless of myopia severity. Among teenagers who had not adopted MCS, many were using SV spectacles for myopia

correction rather than MCS. Cost was identified as the most significant factor influencing the uptake of MCS. An increase in cost was associated with a 36.736.7% reduction in the likelihood that teenagers would adopt MCS. Therefore, a cost-effectiveness analysis should be conducted to assess the cost-effectiveness of implementing myopia control interventions to prevent myopia-related pathologies. The Government of Kenya, through the Ministry of Health (MOH), should prioritize the availability of eye health care services and a range of effective MCS at primary health centers to enhance accessibility, particularly for teenagers. Manufacturers and regulatory bodies should collaborate to facilitate the introduction of various effective MCS into the eye care sector, ensuring their accessibility to ECPs and other relevant stakeholders.

STRENGTHS AND LIMITATIONS

The application of rigorous inclusion and exclusion criteria guaranteed a uniform study cohort and minimized the influence of external variables. Moreover, pilot testing was conducted to verify and enhance the reliability of the questionnaire prior to the main study. As a limitation, the study depended on hospital-based sampling, which may introduce selection bias. Since participants were recruited from an ophthalmology clinic, they may be more prone to vision problems than the general population, potentially leading to elevated prevalence estimates.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

Table 4. Relationship between identified factors and Uptake of MCS among Teenagers of Lurambi Constituency Kenya

Identified Factors influencing Uptake of MCS	Odds Ratio	95% CI	P-Value
Availability of MCS	0.732	[0.453-0.993]	0.043
Suitability of MCS	1.492	[0.932-2.390]	0.096
Cost	1.367	[1.013-1.845]	0.041
Eye doctor preference	0.928	[0.577-1.492]	0.757
Effectiveness of the strategy	0.683	[0.419-1.112]	0.125
Parent Preference	0.717	[0.424-1.210]	0.212
Risk of Myopia Progression	2.052	[1.157-3.642]	0.014
Patient Preference	0.740	[0.408-1.344]	0.323

AUTHOR CONTRIBUTION STATEMENT

DNS contributed to the conceptualization and study design, data collection, analysis and interpretation of data, manuscript writing, project administration, and final approval of the manuscript. AJM contributed to the conceptualization and study design, provided

supervision throughout the research process, and conducted critical review and revision of the manuscript.

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