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Assessment of Myopia Risk Factors and Management Recommendations in a Tertiary Eye Care Centre

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Abstract: **Original Research**

***Background*:** This study aimed to evaluate the clinical profile and factors associated with myopia risk among children and to describe the individualized myopia management strategies recommended at a tertiary eye care centre. ***Methodology*:** A prospective study was conducted at Rotary Eye Hospital, Navsari, from October 2024 to April 2025 and included 125 children aged 6–18 years with myopia. Comprehensive assessment included medical and ocular history, visual acuity, refractive status, indoor and outdoor activity time, ocular parameters including axial length, lens thickness and keratometry, and binocular vision assessment. Myopia risk was assessed based on spherical equivalent and further supported by the LVPEI Myopia Calculator. Patients and their parents were counselled regarding the risk of myopia progression and individualized management options, including spectacle correction, myopia-control spectacles, pharmacological interventions, environmental modifications, and vision therapy. Treatment compliance was assessed at the 3-month follow-up. ***Results*:** Among the 125 children, 69 (55%) were female and 56 (45%) were male, with 65% classified as high risk. The 3-month follow-up compliance rate was 42%, among whom 55% remained in the high-risk category. The recommended management strategies included regular spectacles (89%), myopia-control spectacles (59%), pharmacological interventions (24%), progressive addition lenses (1.5%), vision therapy (8%), and environmental interventions (100%). Multiple regression analysis demonstrated that spherical equivalent was the strongest predictor of axial length ($\beta = -0.851$, $p < 0.001$). Age ($p = 0.029$) and outdoor activity time ($p = 0.012$) were also significantly associated with axial length, whereas indoor activity time was not significantly associated ($p = 0.905$). No significant change in axial length was observed over the 3-month follow-up period. ***Conclusion*:** A substantial proportion of children were classified as being at high risk for myopia progression. Comprehensive assessment of refractive error, ocular parameters, and environmental factors may facilitate individualized myopia management. Myopia-control spectacles and environmental interventions were the most frequently recommended management approaches. The relatively low follow-up compliance emphasizes the need for structured follow-up and adherence strategies in childhood myopia management.

Keywords: Myopia, Myopia Risk Assessment, Myopia Management, Axial Length, Outdoor Activity, Myopia-Control Spectacles.

INTRODUCTION

Myopia (nearsightedness) is one of the most common refractive errors, in that distant objects are seen blurred, and near objects are seen clearly [1]. This condition occurs commonly when the axial length (AXL) of the eye increases, or there is an increased curvature of the cornea, whereby light focuses in front of the retina instead of on the retina [2].

In the 21st century, myopia is a major public health issue. Estimates from 2024 indicate that myopia affected approximately 23% of the global population at that time. These numbers are expected to increase to 50% by 2050, resulting in an additional 1 billion individuals facing the risk of complications that could eventually cause vision loss [3]. Additionally, it is estimated that 4% of myopic patients in India experience complications that may lead to permanent vision impairment [4].

Myopia causes preventable blindness in young people and children [5]. Myopia is a significant threat to public health [6]. The rate of myopia has risen, making it an important public health challenge. Attention is increasingly being directed toward preventing the development and progression of myopia [7].

Myopia is typically diagnosed in children younger than 10 years old and can advance quite rapidly [8]. It is believed that myopia affects around 5% of preschool-aged children, 9% of school-aged kids, and 30% of teenagers [9]. Additionally, myopia generally stabilizes in the late teen years to early adulthood, indicating that myopia control treatment should ideally persist throughout that period [10].

Over 10 years, myopic children have a high risk of retinal detachment [11]. Peripheral anomalies frequently occur in highly myopic children, with DWP being the most prevalent. The youngest child exhibited a single anomaly, while older children frequently displayed multiple anomalies [12]. With the rising incidence and complications of myopia, effective management is crucial to slow its progression.

There are genetic and environmental factors that contribute to myopia, which has been on the rise in children due to increased near work and decreased outdoor activities. As myopia rates have increased, new treatment options have been developed for its management [13].

Myopia management involves delaying its onset, potentially through increased outdoor activities, and slowing progression and reducing onset likelihood with treatments such as atropine and orthokeratology [14]. Increasing outdoor activities may help prevent myopia and decrease the risk for children who are already myopic [15]. Additionally, advice on limiting digital screen time could be beneficial in preventing the ongoing onset of myopia and myopia progression [16].

Evaluate the underlying causes and risk factors of myopia that contribute to progression, establish visual environmental strategies, use optical and pharmaceutical treatments, and effectively communicate the possible risks and benefits of a suggested myopia control method to patients and parents/guardians [17].

Myopia control strategies focus on lowering the progression of myopia and preventing it from advancing. Various clinical approaches can be utilized for myopia control [18].

The American Academy of Ophthalmology provides several myopia control strategies to slow progression, including defocusing spectacles, multifocal soft contact lenses (central distance), orthokeratology lenses, bifocals, progressive addition lenses, and extended depth of focus contact lenses. For rapid progression of high myopia, atropine 0.01% may be recommended. The duration of outdoor time and screen use are also significant factors in myopia management [19].

Early identification of risk factors can help recognize long-term risks and enhance recommendation efficacy [20]. The LVPEI myopia calculator was used to assess the risk (high-low) of myopia progression [21]. A risk-based classification educates parents about the potential for myopia progression and the importance of taking timely measures to manage it [22].

This study was designed to assess the clinical profile of myopic children, identify risk factors associated with myopia progression, and document the distribution of recommended myopia management strategies at a tertiary eye care center.

METHODOLOGY

This prospective research was carried out at the Rotary Eye Hospital, Navsari, from October 2024 to April 2025 period of 7 months. The study was approved by the REI Ethics Committee (Approval No. REIEC/03/2024) and was conducted in accordance with the Declaration of Helsinki.

This study included 125 patients aged between 6 to 18; Participants were further categorized into four age subgroups: 6–9 years, 10–12 years, 13–15 years, and 16–18 years to allow age-wise analysis of myopia risk and management patterns.

Detailed patient information, including medical history and time spent on indoor and outdoor activities, was collected. Visual acuity was assessed with and without previous spectacle correction, and details of existing spectacles were recorded. Subjective refraction was performed for all participants. Children with a spherical equivalent refractive error ranging from more than −0.50 D to −15.00 D were included in the study.

Based on the degree of myopia, patients were categorized into risk groups. A spherical equivalent of ≥ −5.00 D was classified as the high-risk category, while a spherical equivalent of < −5.00 D was classified as the low-risk category, in accordance with published myopia studies.

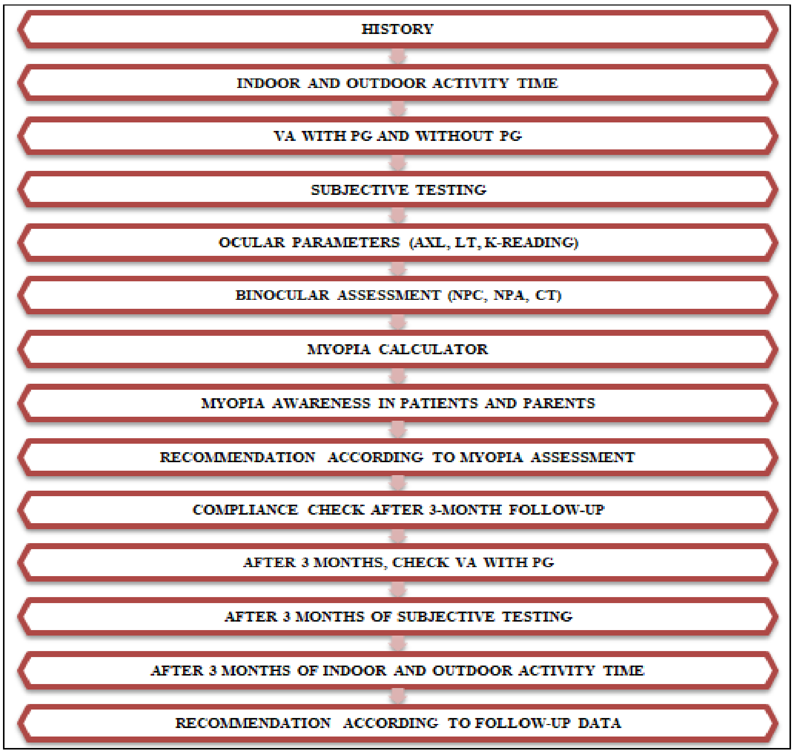
Risk categorization was primarily based on spherical equivalent cut-off values and was further supported by the LVPEI myopia calculator for clinical risk assessment.

Every patient who was diagnosed with refractive error myopia underwent a myopia risk assessment, a comprehensive eye examination, ocular parameters Axial length (AXL), Lens thickness (LT), K-readings, and binocular assessment (NPC, NPA, cover test), as shown in flow chart 1.

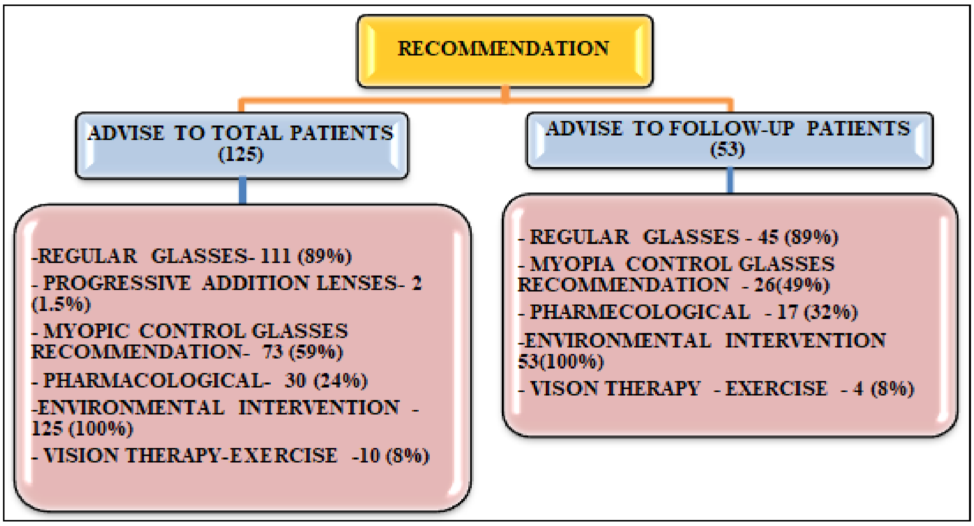
We used the LVPEI Myopia Calculator (https://missionmyopia.lvpei.org/) to assess the risk of myopia progression. The risk was determined by comparing the child's previous spectacle prescription with the current prescription, which helped us classify patients into high-risk and low-risk categories.

Parents were counselled about the risks of myopia progression and the available myopia control options. These included single-vision spectacle correction, myopia control spectacles, bifocal or progressive addition lenses (PAL), pharmacological treatment, environmental modifications, and vision therapy, including red light therapy.

Based on the risk assessment, one or a combination of treatment strategies was recommended to slow myopia progression. Treatment compliance was evaluated at a 3-month follow-up visit.

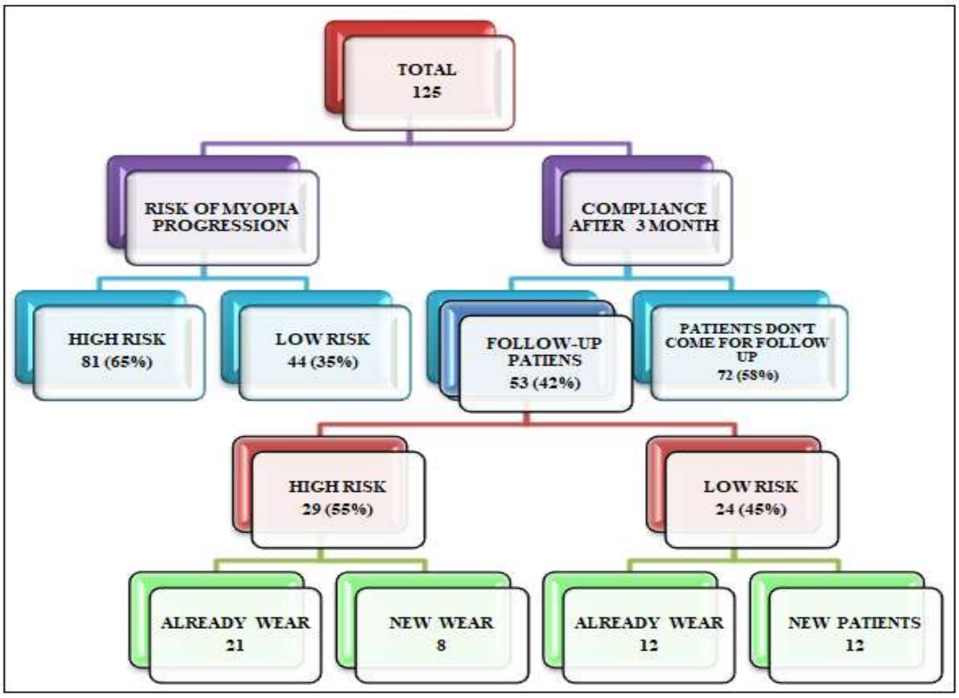


Flow chart 1: MYOPIA RISK ASSESSMENT



Flow chart 2: Distribution of Myopia Management Strategies Based on Risk Category

RESULTS



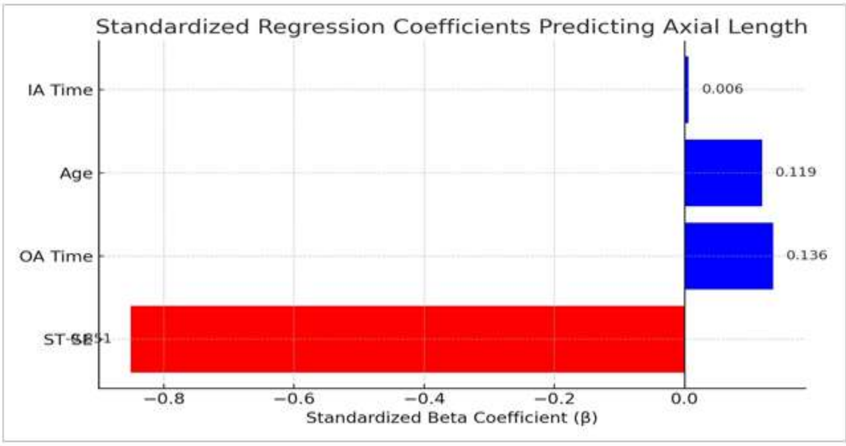
Flow chart 3: Descriptive Analysis of Myopia Children

Table 1: Multiple Regression predicting Axial length

Predictor	B (Unstandardized)	Std. Error	B (Standardized)	t	p-value	95% CI for B
(Constant)	22.261	0.412	—	54.048	<.001	[21.444, 23.078]
Age	0.055	0.025	0.119	2.214	**.029**	[0.006, 0.105]
OA Time	0.008	0.003	0.136	2.551	**.012**	[0.002, 0.014]
IA Time	0.000	0.002	0.006	0.120	.905	[-0.003, 0.003]
Subjective Refraction SE	-0.356	0.021	-0.851	-16.629	**<.001**	[-0.398, - 0.313]

Subjective Refraction: SE = Spherical Equivalent; OA Time = Outdoor Activity Time; IA Time = Indoor Activity Time.

Multiple linear regression **R = 0.862**, **R^2 = 0.743**, **Adjusted R^2 = 0.733, F(4,101) = 73.132**, **p < 0.001, Durbin-Watson = 0.939** revealed Spherical equivalent as the primary predictor of AXL (β = -0.851, p < .001), with age (p = .029) and outdoor time (p = .012) also playing significant roles, whereas indoor activities showed no predictive value.

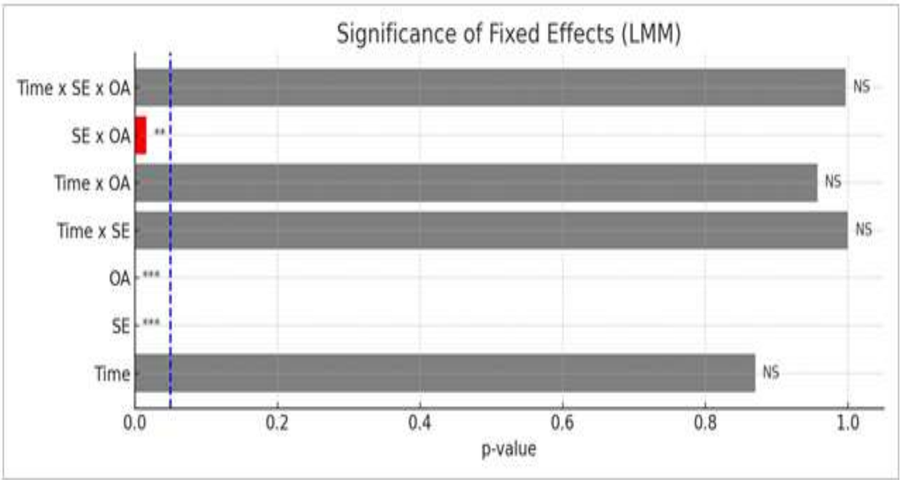


Graph 1: Standardized Regression Coefficient Predicting Axial Length

Table 2: Linear Mixed Model

Effect	F-value (df)	p-value	Significance	Interpretation
Time	F(1, 73) = 0.027	0.870	Not Significant	No measurable change in axial length over 3 months
SE	F(47, 73) = 18.793	<. .001	Highly Significant	More myopic SE is associated with longer AXL
OA	F(5, 73) = 6.948	<..001	Significant	More outdoor time influences AXL
IA	—	> 0.1	Not Significant	Indoor time is not associated with AXL
SE × OA	F(38, 73) = 1.795	0.016	Significant	SE effect depends on the level of outdoor activity.
Time × SE	F(27, 73) = 0.188	1.000	Not Significant	No time-dependent effect of SE
Time × OA	F(4, 73) = 0.162	0.957	Not Significant	No time-dependent effect of OA
Time × IA	—	> 0.5	Not Significant	No time-dependent effect of IA
Time × Risk	F(11, 73) =0.205	0.997	Not Significant	No effect of risk category over time

The linear mixed model analysis confirmed that both SE and outdoor activity significantly predicted AXL. Over three months, no significant changes in AXL. Overall, these findings show the importance of considering refractive error alongside environmental behaviors like outdoor activity in evaluating axial elongation in children.



Graph 2: Significance of Fixed Effects LINEAR MIXED MODEL

DISCUSSION

Myopia is a common form of refractive error. By the year 2050, it is estimated that 5 billion people worldwide will have myopia, with more than 1 billion of them likely developing high myopia [3]. The most significant independent risk factor for myopia is its earlier onset.

Myopia control strategies practiced in everyday life are important in slowing the myopia progression and reducing the risk for vision impairment in the long term [23].

The IMI white paper, Clinical Management Myopia guideline, presents best practice guidelines for myopia management, emphasizing a multidisciplinary approach that includes myopia's causes, risk factors, environmental interventions, and treatments. These guidelines should clearly explain the risks and benefits of treatments to patients and their caregivers. They provide a structured framework for clinicians to evaluate and manage myopia across its different stages (onset, during progression, and stabilization) [24].

The IMPACT guidelines for managing clinical myopia suggested the six steps include: 1. Identify the Type of Axial Myopia, 2. Create a Risk Factor Map 3. Select Progressive Myopes 4. Appropriate Therapy Strategy 5. Consult, Advise, Integrate, and Maintain Close Observation 6. Myopia Control Treatment Reduction and Cessation: This approach contributes to enhancing the quality and standardization of care for myopia control [25].

In our research, 65% patients were at high risk for myopia progression. Gender-specific distribution of high risk was slightly higher in females (43) than in males (38). Follow-up compliance at three months was 42%. Among those, 55% were at high risk.

Most patients were prescribed regular glasses 111 (89%), while 73 (59%) were advised myopia control glasses. All patients received counseling regarding environmental adjustments, such as increasing outdoor activities, while a few 30 (24%) and 10 (8%) were given pharmacological or VT exercise recommendations. The risk pattern in follow-up out of 33, 21 children showed that those who already used glasses had a larger proportion in the high-risk category.

Most children were orthophoria; many exhibited exophoria/exotropia, particularly more prevalent in the high-risk group.

The mean age was 11.1 years. The AXL of both eyes was approximately 24.98 mm, and SE values indicated moderate myopia from study measurements.

Myopia risk assessment requires consideration of environmental factors, including outdoor activity time and refractive errors, alongside axial elongation. This research indicates the importance of early identification, regular monitoring, and proactive intervention, encourages more outdoor activity, and specialized optical treatments are crucial for myopia progression, leading to improved patient compliance.

This study did not compare the effectiveness of different myopia management strategies, as it was observational in nature with a short follow-up period. Future longitudinal studies are required to compare treatment outcomes.

CONCLUSION

The study concludes that various factors affect myopia and increase the risk of visual impairment. Myopia progression can be controlled in children with different treatment strategies. Multiple treatment options were suggested to parents for myopia control. This study recommended and advised 59% of myopia-control spectacles. Non-interventional measures, particularly increased outdoor activities, play an important role in slowing myopia progression. Binocular vision anomalies are crucial, and many children affected with different conditions need to be managed first. The compliance of children was about 42%. Myopic patients require comprehensive eye exams on myopia factors and a well-defined compliance strategy for the myopia control and prevention of visual impairment in children.

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