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Binocular Vision Dysfunction and Myopia Progression: A Prospective Study at a Tertiary Eye Hospital in North India

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ABSTRACT

Purpose: To evaluate the association between binocular vision dysfunctions (BVDs) and myopia progression in children attending a tertiary eye hospital in North India.

Methods: A prospective observational study was conducted at a tertiary eye hospital in North India between April 2024 and March 2025. A total of 543 myopic children aged 6–18 years were enrolled; 369 completed 12 months of follow-up. Participants underwent comprehensive refractive, biometric, and binocular vision assessments. Myopia severity was categorized as mild (–0.50 D to –3.00 D), moderate (–3.00 D to –6.00 D), or high (> –6.00 D). BVDs were classified using Scheiman and Wick clinical criteria. Refractive progression was analyzed by changes in spherical equivalent refraction (SER) and axial length. Outcomes were compared among children with normal binocular vision, untreated BVD, and BVD receiving therapy.

Results: Normal binocular vision declined significantly with increasing myopia severity (70.3% in mild, 55.6% in moderate, and 29.7% in high myopia; $p < 0.001$). Convergence insufficiency (24.3%) and intermittent exotropia (24.8%) were most common in high myopes. Accommodative dysfunctions were less frequent but linked to high myopia. Over 12 months, untreated BVD was associated with greater myopia progression (–0.36 D, $p = 0.0026$) compared to children with normal binocular function (–0.30 D, $p = 0.0023$). Children receiving BVD therapy showed slower, non-significant progression (–0.27 D, $p = 0.1883$). Specific subtypes such as basic exophoria and accommodative infacility carried higher risk of progression. Axial length elongation paralleled refractive changes, confirming its role as a key biomarker.

Conclusion: BVDs, particularly vergence anomalies, are highly prevalent in children with moderate-to-high myopia and are associated with faster refractive progression when left untreated. Vision therapy may help stabilize myopia, though larger and longer-term studies are needed to confirm its protective role. Routine screening and early management of BVDs should be integrated into pediatric myopia control strategies.

Keywords: *Myopia progression, binocular vision dysfunction, convergence insufficiency, intermittent exotropia, accommodative dysfunction, axial length, pediatric vision therapy*

INTRODUCTION

Myopia, or nearsightedness, has rapidly evolved from a common refractive error to a significant global public health concern. Characterized by a refractive state in which parallel rays of light focus in front of the retina when accommodation is at rest, myopia not only causes blurred distance vision but is increasingly associated with ocular complications such as retinal detachment, glaucoma, and myopic maculopathy [1]. The global prevalence of myopia has been rising at an alarming rate, particularly in children. Holden et al. estimated that by 2050, nearly 50% of the world's population—approximately 5 billion people—may be affected by myopia, with nearly 1 billion at risk of high myopia and its associated pathologies [2].

India is experiencing a similar trend, with a marked increase in myopia prevalence among urban school-aged children.

Multiple regional studies have reported myopia prevalence ranging from 13% to 34% in urban Indian populations, attributed to increased academic pressure, prolonged near work, and reduced outdoor activity [3]. This rising burden calls for deeper understanding of modifiable risk factors and functional visual anomalies that may contribute to myopia development and progression.

One area of growing interest in recent years is the **association between binocular vision dysfunctions (BVDs)** and myopia. Binocular vision involves the coordination of both eyes for clear and single vision. Disruptions in this system—including convergence insufficiency, fusional vergence anomalies, and accommodative dysfunctions—can lead to

symptoms such as eyestrain, blurred vision, diplopia, poor reading performance, and visual fatigue [4]. These symptoms may be subtle or unreported in children, but they can significantly affect visual comfort and efficiency, especially during sustained near tasks such as reading or digital screen use [5].

Several studies have shown that children with myopia may exhibit a higher prevalence of BVDs compared to emmetropes. For instance, convergence insufficiency (CI), a condition where the eyes have difficulty working together while focusing on a near object, is more frequently observed in myopic children [6]. Similarly, accommodative anomalies such as accommodative insufficiency (AI) and accommodative infacility (AIF) are associated with both visual fatigue and near task difficulties, which may lead to compensatory behaviors such as excessive near focusing or altered working distances—factors implicated in the acceleration of myopia progression [7].

The relationship between BVDs and myopia is theorized to be **bi-directional**: while binocular and accommodative stress may contribute to myopia onset and progression, increased axial length and altered ocular biomechanics in myopes may in turn affect vergence and accommodative functions [8]. Furthermore, a mismatch between the accommodative and vergence demands (i.e., abnormal AC/A ratio) has also been observed in progressing myopes, suggesting complex neuromuscular interactions between refractive development and binocular vision function [9].

Despite growing international evidence, there is limited Indian data exploring this relationship using a **standardized clinical protocol.** Most studies from India have either lacked comprehensive binocular assessment or focused solely on refractive parameters. Moreover, tertiary care eye hospitals serve as key referral centers, and evaluating children attending myopia clinics in such settings can yield insights into clinically significant binocular anomalies that may otherwise go undetected in routine screenings.

This prospective study aims to fill this gap by investigating the **relationship between myopia severity and the prevalence of binocular vision and accommodative dysfunctions** among children aged 6 to 18 years attending a pediatric myopia clinic at a tertiary care eye hospital in North India. By applying established clinical criteria (Scheiman and Wick) and standardized binocular vision testing, this study seeks to assess how BVDs vary across different levels of myopia and highlight the need for integrated binocular vision screening in pediatric myopia management.

METHODS

This prospective, observational study was conducted at the Myopia and Binocular Vision Therapy (BVT) Clinic of Dr. Shroff's Charity Eye Hospital, a tertiary care center in New Delhi, India, over one-year period from April 2024 to March 2025. The study enrolled 543 children between the ages of 6 and 18 years who presented with myopia, defined as a spherical equivalent (SE) of ≥ –0.50 diopters (D) in at least one eye. Ethical clearance was obtained from the institutional review board, and informed written consent was taken from parents or guardians, with assent from the children.

Children were included if they had myopia within the defined range, best-corrected visual acuity (BCVA) of 20/25 or better in both eyes, and no history of ocular or systemic conditions that could affect binocular vision. Exclusion criteria included previous ocular surgery, strabismus with constant deviation at distance or near, amblyopia (BCVA worse than 20/30), neurological or systemic disorders affecting visual function, and current use of medications that may influence accommodation or vergence. Children already undergoing orthoptic or vision therapy were also excluded.

Each participant underwent a comprehensive ophthalmic and binocular vision evaluation by experienced optometrists. Refractive status was determined after cycloplegia using 1% cyclopentolate, and SE was calculated as the sphere plus half the cylindrical correction. Ocular biometry was performed using non-contact optical biometry (e.g., IOLMaster), measuring axial length (AL), anterior chamber depth (ACD), central corneal thickness (CCT), and keratometry (K1 and K2). In order to avoid inter-eye correlation bias, only the data from the right eye were used for all statistical analyses, as there was no statistically significant difference in SE between the two eyes ($p = 0.4510$; 95% CI), as shown in Table 1.

Binocular vision assessment included a battery of standardized clinical tests. Cover tests for distance and near were used to identify any phorias or tropias. Near point of convergence (NPC) was measured using an accommodative target, with a break point of ≥6 cm considered abnormal. Near point of accommodation (NPA) was assessed monocularly using the Donder's push-up method. Fusional vergence amplitudes (positive and negative) were evaluated at both distance and near using prism bars. Accommodative facility was tested with ±2.00 D flippers at 40 cm, with values <6 cycles/min for monocular testing and <3 cycles/min for binocular testing considered below normal limits. Additional accommodative tests included

measurement of negative and positive relative accommodation (NRA and PRA) and calculation of the AC/A ratio using the gradient method. Monocular Estimation Method (MEM) dynamic retinoscopy was performed to evaluate accommodative response.

All binocular vision dysfunctions (BVDs) were classified using the clinical diagnostic criteria outlined by Scheiman and Wick, which involve evaluating a cluster of signs to diagnose conditions such as convergence insufficiency, accommodative insufficiency, accommodative infacility, and various forms of vergence dysfunctions.

To examine the influence of myopia severity on binocular vision performance, participants were stratified into three groups based on SE: mild (≥ –0.50 D to < –3.00 D), moderate (≥ –3.00 D to < –6.00 D), and high (≥ –6.00 D). Statistical analysis was conducted using IBM SPSS Statistics version 29. Descriptive statistics, including means and standard deviations, were calculated for all continuous variables. Group comparisons were made using chi-square tests and one-way ANOVA, where appropriate. Pearson's correlation was used to examine the relationship between SE and specific binocular parameters, such as NPC and fusional vergence ranges. A p-value less than 0.05 was considered statistically significant.

RESULTS

Out of 543 myopic children aged 6–18 years who were enrolled, 369 completed the one-year follow-up and were included in the final analysis. The average age of the participants was 12.5 years (±3.61), covering a wide range from early childhood to late adolescence. This age range made it possible to study binocular vision and accommodation during key years when myopia often starts and progresses. The gender distribution was nearly equal, with 184 boys (49.8%) and 185 girls (50.2%). This balance reduces bias and makes the results more reliable for both boys and girls (Table 1).

Table 1. Baseline demographic data of Myopic children included in analysis

Parameter	**Value / Distribution**
Total number of participants	369
Age (mean ± SD, years)	12.5 ± 3.61
Gender distribution	Male: 184 (49.8%), Female: 185 (50.2%)
Myopia classification (SE)	
Mild (–0.50 D to –3.00 D)	143 (39%)
Moderate (–3.00 D to –6.00 D)	75 (20%)
High (> –6.00 D)	151 (41%)

The average spherical equivalent (SE) was –5.43 diopters (D) in the right eye and –5.04 D in the left eye. The variation (SD) was ±3.72 D for the right eye and ±3.42 D for the left. The standard error of the mean (SEM) was 0.39 D for the right eye and 0.36 D for the left, showing good precision of the averages. A statistical test was done to check for differences between the two eyes, and the p-value was 0.4510, meaning there was no significant difference at the 95% confidence level. Because of this, only right eye data were used in later analyses to avoid redundancy and inter-eye correlation

Among the children studied, 143 (40.2%) had mild myopia (–0.50 D to –3.00 D), 75(20.6%) had moderate myopia (–3.00 D to –6.00 D), and 151 (40.2%) had high myopia (greater than –6.00 D). The number of children with high myopia was almost the same as those with mild myopia, giving a strong base to compare binocular vision problems across different levels of severity. The moderate group was smaller, which likely reflects the way children are referred to clinics—either for early detection in mild cases or for advanced care in high myopia.

Table 2. presents a comparative analysis of key ocular biometric parameters across three groups of myopic children—mild, moderate, and high—based on spherical equivalent (SE) classification. The aim is to assess how biometric variables correlate with increasing severity of myopia. All values are reported as mean ± standard deviation (SD**)**, and the associated p-values indicate the statistical significance of differences among the three groups.

The mean spherical equivalent (SE) significantly differed across groups: –1.98 D in mild, –4.43 D in moderate, and –6.80 D in high myopia ($p < 0.001$), confirming appropriate classification. Axial length (AL) increased with severity (24.15 mm to 25.69 mm, $p < 0.001$), supporting its role in myopia progression. Anterior chamber depth (ACD) and lens thickness showed no significant differences ($p > 0.05$), suggesting minimal influence on refractive error. Central corneal thickness (CCT) varied significantly ($p < 0.001$), but inconsistently across groups, indicating possible structural variation. Pupil size also

differed significantly ($p < 0.001$), with larger pupils seen in mild myopes; this may reflect higher visual demand or accommodative effort.

Table 2. Correlation between Myopia and ocular Biometry				
Parameters	**Mild (–0.50 D to –3.00 D)**	**Moderate (–3.00 D to –6.00 D)**	**Severe (> –6.00 D)**	**P value**
Myopia (Mean, SD)	-1.98 ± 0.76	-4.43± 0.90	-6.80 ± 2.63	(p < 0.001)
Axial Length (mm)	24.15± 00.97	24.82± 0.87	25.69 ± 1.32	(p < 0.001)
AC Depth(mm)	3.77 ± 0.27	3.80 ± 0.24	3.75± 0.24	*(p > 0.05)*
Lens Thickness(MM)	3.32 ± 0.71	3.32 ± 0.19	3.36 ± 0.17	*(p > 0.05)*
Central Corneal Thickness (µm)	536.79 ± 37.44	508.17 ± 21.85	534.42 ± 34.65	(p < 0.001)
Pupil Size(MM)	7.08 ± 1.58	6.54 ± 1.18	6.87 ± 2.19	(p < 0.001)
Parameters are given as mean ± SD				

The distribution of various binocular vision dysfunctions (BVDs) among children with different levels of myopia severity. A clear trend was observed showing a significant decline in the prevalence of normal binocular vision as myopia severity increased. While 70.3% of children with mild myopia had normal binocular function, this dropped to 55.6% in the moderate myopia group and further to just 29.7% among high myopes, a difference that was statistically significant ($p < 0.001$). Convergence insufficiency (CI) and intermittent exotropia (IXT) were the most frequently observed dysfunctions in moderate and high myopes. CI was noted in only 3.8% of mild myopes but increased to 10.8% in moderate and 24.3% in high myopia ($p < 0.001$) [table.3]. A similar pattern was seen for IXT, rising from 6.2% in mild myopes to 22.5% and 24.3% in moderate and high myopia groups respectively ($p < 0.001$). Although basic exophoria appeared more commonly in mild myopes (13.3%) than in the other groups, this difference was not statistically significant ($p = 0.071$). Esophoria, though less prevalent overall, was significantly more common in moderate and high myopes (5.4% in each group) compared to just 0.8% in mild myopia ($p = 0.004$).

Accommodative anomalies were less prevalent overall but still showed trends worth noting. Accommodative insufficiency was reported in 2.4% of mild and 2.9% of high myopes, with none reported in the moderate group ($p < 0.05$), while accommodative infacility occurred in 3.8% of mild and 2.9% of high myopes, with none in the moderate group, though this difference was not statistically significant ($p > 0.05$). Most notably, when considering the presence of any BVD, the prevalence increased substantially from 29.7% in mild myopes to 44.4% in moderate and 70.3% in high myopes ($p < 0.001$), confirming a strong association between myopia severity and binocular vision dysfunction[table.3].

These findings underscore the need for routine binocular vision assessments, especially in children with moderate to high myopia, to facilitate early detection and management of associated visual dysfunctions.

Table 3. Incidence of Binocular Vision Dysfunction (BVD) by Myopia Severity (n = 369)				
Type of BVD	**Mild Myopia (n=143)**	**Moderate Myopia (n=75)**	**High Myopia (n=151)**	**p-value**
Normal Binocular Vision	101(70.3%)	42 (55.6%)	45 (29.7%)	< 0.001
Convergence Insufficiency (CI)	5 (3.8%)	8 (10.8%)	37 (24.3%)	< 0.001
Intermittent Exotropia (IXT)	9 (6.2%)	17 (22.5%)	37 (24.8%)	< 0.001
Basic Exophoria	18 (12.5%)	4 (5.4%)	15 (10.8%)	0.071
Esophoria	1 (0.8%)	4 (5.4%)	8 (5.4%)	0.004
Accommodation Insufficiency	3 (2.4%)	0 (0%)	4 (2.9%)	**(p < 0.05)**
Accommodation Infacility	5 (3.5%)	0 (0%)	4 (2.9%)	*(p > 0.05)*
Any BVD	42 (29.7%)	33 (44.4%)	106 (70.3%)	< 0.001
PD, prism diopter; *NFV*, negative fusional vergence; *PFV*, positive fusional vergence; *NPC*, near point of convergence				

Table 4 outlines the relationship between various subtypes of binocular vision dysfunctions (BVDs) and the progression of myopia during the study period. In the control group (children without BVD), the mean change in spherical equivalent (SE) was –0.298 D, with a corresponding axial length (AL) increase of 0.1978 mm; 25.5% of these children experienced a progression of ≥0.50 D.

Among the BVD subgroups, children with esophoria exhibited the greatest proportion of progression (60%) and the largest mean AL elongation (0.236 mm), although this trend was not statistically significant ($p = 0.4493$). Children with accommodative infacility demonstrated the largest mean SE shift (–0.69 D), and all participants in this subgroup (100%)

showed progression; this result approached statistical significance (p = 0.0577). In comparison, the basic exophoria group showed a lower rate of progression (30%), but the association was statistically significant (p = 0.0471).

When analyzed collectively, the presence of any BVD was associated with a significantly higher risk of myopia progression compared to the non-BVD group (p = 0.0001). These findings indicate that accommodative and fusional anomalies, in particular, may be important contributors to faster myopia progression.

Table 4. Association Between Binocular Vision Dysfunction (BVD) and Myopia Progression Over Time

BVD Type	Number of Patients (n)	Mean Baseline SE (D)	Mean SE Change (D)	Mean Axial Length Change (mm)	% with ≥0.50D Myopia Progression	p-value
No BVD (Control Group)	187	-4.41223	-0.298	0.1978	25.53%	**0.0023**
Convergence Insufficiency (CI)	50	-7.63	-0.277	0.218	28.6%	0.1574
Intermittent Exotropia (IXT)	63	-5.61	-0.27	0.126	21.4%	0.0687
Basic Exophoria	37	-5.61	-0.31	0.155	30%	**0.0471**
Esophoria	15	-8.75	-0.5	0.236	60%	0.4493
Accommodation Insufficiency	8	-9.25	0.0	0.0	0.0%	
Accommodation Infacility	9	-5.38	-0.69	0.085	100%	**0.0577**
Any BVD (Combined Group)	182	-5.43	-0.31	0.17	26.1%	**0.0001**

Table 5 demonstrate the longitudinal changes in spherical equivalent refraction (SER) over a 12-month period among three study cohorts: children with binocular vision dysfunction (BVD) receiving therapy, children with untreated BVD, and children with normal binocular vision.

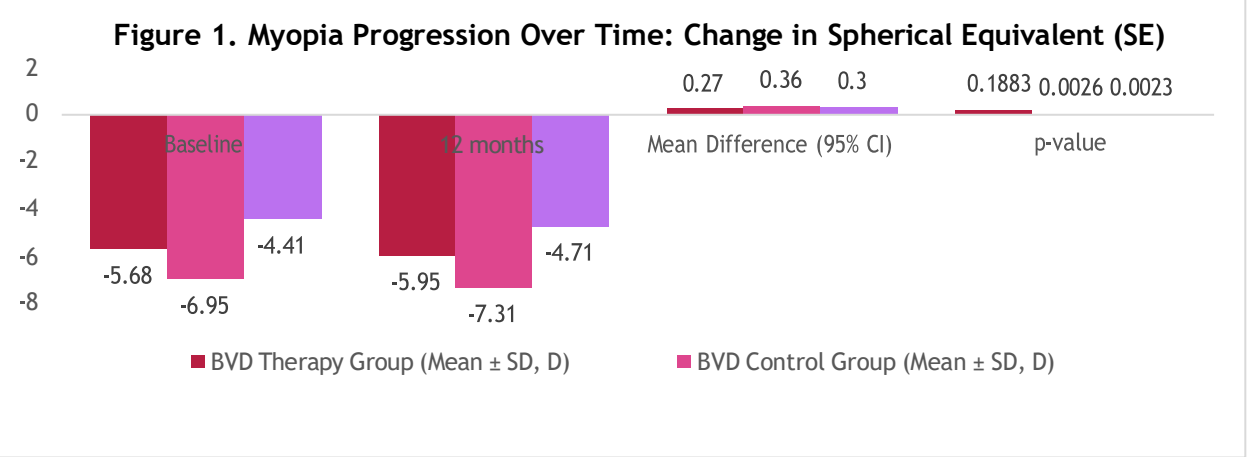
In the BVD therapy group, the mean SER shifted from –5.68 D at baseline to –5.95 D at 12 months, indicating a mean progression of 0.27 D. This change did not reach statistical significance (p = 0.1883). Conversely, the untreated BVD group exhibited a greater myopic shift, from –6.95 D to –7.31 D, with a mean progression of 0.36 D, which was statistically significant (p = 0.0026). The cohort with normal binocular vision also demonstrated significant myopic progression, with a mean change of 0.30 D (p = 0.0023).

Taken together, these findings indicate that although all groups showed progression in myopia over the 12-month period, the greatest and most statistically significant progression was observed among children with untreated BVD. BVD therapy was associated with a comparatively smaller degree of refractive progression; however, the reduction in progression did not achieve statistical significance within the study sample.

Table 5. Myopia Progression Over Time: Change in Spherical Equivalent Refraction (SER)

Time Point	Baseline	12 months	Mean Difference (95% CI)	p-value
BVD Therapy Group (Mean ± SD, D)	-5.68± 2.78	-5.95±2.55	0.27	0.1883
BVD Control Group (Mean ± SD, D)	-6.95± 4.54	-7.31±4.58	0.36	**0.0026**
Normal Binocular Function Group (Mean ± SD, D)	-4.41±3.122	-4.71±3.18	0.30	**0.0023**

The myopia progression over 12 months was least in the BVD therapy group (–0.27 D, not significant), compared to significant progression in the BVD control (–0.36 D) and normal vision groups (–0.30 D). This suggests therapy may help slow myopia progression. **[figure.1]**



Over 12 months across different BVD therapy subgroups, all categories showed slight myopic progression, but none reached statistical significance. The largest mean change was seen in the convergence insufficiency group (–0.83 D, p = 0.4226), followed by intermittent exotropia (–0.26 D, p = 0.1934). Minimal changes were observed in basic exophoria, esophoria, and accommodation insufficiency, all with non-significant p-values.

The combined BVD therapy group showed a modest progression (–0.27 D), also not significant (p = 0.1883) **[table.6].** These findings suggest that BVD therapy may help stabilize myopia, though effects vary across subtypes.

Table 6. Myopia Progression Over Time: Change in SER in various BVD categories Therapy groups

	BVD Therapy Group (Mean ± SD, mm)			
Time Point	**Baseline**	**12 months**	**Mean Difference (95% CI)**	**p-value**
Convergence Insufficiency (CI)	-6.50 ± 4.98	-7.33 ± 3.54	0.8333	0.4226
Intermittent Exotropia (IXT)	-5.58 ± 2.05	-5.84± 2.00	0.26250	0.1934
Basic Exophoria	-2.43750	-2.42850	-0.00900	0.5000
Esophoria	-3.6250	-3.6850	0.0600	0.5000
Accommodation Insufficiency	-8.87500	-8.93750	0.06250	1.0000
Accommodation Infacility	-		-	-
Any BVD Therapy (Combined Group)	-5.68 ± 2.78	-5.95 ± 2.55	0.27344	0.1883

Table 7 reports the 12-month changes in spherical equivalent refraction (SER) among children with different subtypes of binocular vision dysfunctions (BVDs) who did not receive therapy. All subgroups demonstrated myopic progression, although the degree of change varied.

For the overall BVD control group, the mean progression was –0.36 D, which was statistically significant (p = 0.0026). Within the subgroups, basic exophoria showed a significant progression of –0.35 D (p = 0.0458). Intermittent exotropia (–0.28 D) and convergence insufficiency (–0.13 D) also progressed, but the changes were not significant. Children with accommodative infacility exhibited a larger mean shift (–0.69 D), which approached statistical significance (p = 0.0577). Esophoria showed the highest mean progression (–1.63 D); however, this was not statistically significant, likely due to the limited sample size (p = 0.3855).

In summary, untreated BVDs were consistently associated with myopia progression, with subtypes such as basic exophoria and accommodative infacility showing greater levels of risk.

Table 7. Myopia Progression Over Time: Change in SER in various BVD categories control group				
	BVD Control Group (Mean ± SD, mm)			
Time Point	**Baseline**	**12 months**	**Mean Difference (95% CI)**	**p-value**
Convergence Insufficiency (CI)	-7.94± 4.51	-8.07 ± 4.60	0.12500	0.18400
Intermittent Exotropia (IXT)	-5.70 ± 2.25	-5.98 ± 2.48	0.27500	0.2155
Basic Exophoria	-5.97 ± 5.78	-6.32 ± 5.62	0.35	**0.0458**
Esophoria	-10.62 ± 2.65	-12.25± 1.06	1.6250	0.3855
Accommodation Insufficiency	-		-	-
Accommodation Infacility	-5.38 ± 4.42	-6.06± 4.51	0.69	**0.0577**
Any BVD (Combined Group)	-6.95 ± 4.54	-7.31 ± 4.58	0.36207	**0.0026**

DISCUSSION

This prospective study evaluated the relationship between binocular vision dysfunctions (BVDs) and myopia progression in children attending a tertiary eye hospital in North India. The results highlight a significant association between the severity of myopia and the prevalence of BVDs, particularly convergence insufficiency (CI) and intermittent exotropia (IXT), and suggest that untreated BVDs may contribute to greater myopia progression over time.

Our findings show that the prevalence of normal binocular function decreases markedly with increasing myopia severity, from 70.3% in mild myopes to only 29.7% in high myopes (Table 4). Convergence insufficiency and intermittent exotropia were the most common BVDs, affecting nearly one-fourth of children with high myopia. This observation supports the hypothesis that greater refractive error places additional stress on the vergence system, potentially unmasking latent binocular anomalies [10,11]. Possible mechanisms include increased demand for convergence during near tasks and lag of accommodation, both of which may strain binocular coordination and contribute to myopia progression [12].

Biometric analysis further supports these relationships. Axial length was significantly greater in high myopes (25.69 mm) compared to mild myopes (24.15 mm, $p < 0.001$), confirming axial elongation as the primary structural determinant of myopia progression (Table 3). However, anterior chamber depth and lens thickness did not vary significantly, suggesting these parameters play a limited role in refractive differences in this pediatric cohort, consistent with prior reports [13].

The longitudinal data provide additional insight. Children without BVDs progressed by –0.30 D over 12 months, whereas those with untreated BVDs (control group) showed greater progression (–0.36 D, $p = 0.0026$), particularly in basic exophoria and accommodative infacility subgroups (Table 8). In contrast, children receiving BVD therapy demonstrated slower, non-significant progression (–0.27 D, $p = 0.1883$, Table 6–7), suggesting that addressing binocular dysfunction may help stabilize refractive change. Although not conclusive, this trend aligns with emerging evidence that management of binocular stress could play a role in myopia control [13].

Our results are consistent with previous studies. The BAND (Binocular Vision Anomalies in Near-sighted Development) study reported that children with CI were more likely to exhibit faster myopia progression compared to those with normal binocular function [6]. Similarly, Maharjan et al. (2022) reported higher prevalence of CI and IXT in progressing myopes in South Asian cohorts [14]. Recent work by Chakraborty et al. (2025) also emphasized the role of accommodative lag and vergence anomalies as potential contributors to myopia progression in school-aged children [15]. These findings, taken together with our data, highlight the importance of integrating binocular vision evaluation into pediatric myopia care.

The clinical implication of our study is clear: early identification and management of BVDs, particularly CI and IXT, should be considered as part of comprehensive myopia control protocols. Interventions such as orthoptic therapy, accommodative facility training, or prism correction may help relieve visual strain, improve quality of life, and potentially reduce progression risk [16].

Nonetheless, certain limitations must be acknowledged. This was a single-center study, limiting generalizability across diverse populations. The follow-up period of 12 months, though sufficient to detect early trends, may not fully capture the long-term impact of BVDs on refractive progression. Additionally, the absence of a non-myopic control group restricts comparison of BVD prevalence between myopic and emmetropic children. Future research should focus on multicenter, longitudinal studies tracking outcomes of BVD-treated versus untreated children to better establish causal relationships and quantify the protective effect of therapy.

CONCLUSION

This prospective study conducted at a tertiary eye hospital in North India demonstrates a significant association between the severity of myopia and the prevalence of binocular vision dysfunctions in children. Convergence insufficiency and intermittent exotropia were the most frequent anomalies, particularly among moderate-to-high myopes, while accommodative dysfunctions were relatively less common. Axial length showed a strong correlation with myopia progression, whereas other biometric parameters such as anterior chamber depth and lens thickness remained stable across groups. Importantly, children with untreated BVDs experienced greater myopia progression over time, while those receiving therapy showed relatively slower, non-significant progression, suggesting a potential stabilizing effect of intervention.

These findings emphasize the importance of incorporating routine binocular vision assessments into pediatric myopia management protocols. Early detection and treatment of binocular vision dysfunctions could not only alleviate visual symptoms and improve quality of life but may also play a role in slowing myopia progression. However, larger multicenter and longer-term longitudinal studies are needed to confirm these associations and to evaluate the long-term impact of targeted BVD therapy on refractive development in children.

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