Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Ophthalmology

Screening-Based Assessment of Refractive Errors and Amblyopia in Children Attending an Eye Care Facility

Dr. A.K.M. Mamunur Rahman[1*], Dr. Kripadhan Chakroborty[2], Prof. Dr. A. H. M. Enayet Hussain[3], Dr. Dewan Fazle Ghani[4], Dr. Rafia Islam Jui[5]

[1]Associate Professor, Department of Ophthalmology, Jahurul Islam Medical College, Kishoreganj, Bangladesh
[2]Associate Professor, Department of Ophthalmology, Kumuduni Women's Medical College, Mirzapur, Tangail, Bangladesh
[3]Professor and Head, Department of Pediatric Ophthalmology and Strabismus, National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh
[4]Junior Consultant, Department of Ophthalmology, Ispahani Islamia Eye Institute and Hospital, Dhaka, Bangladesh
[5]Student, Department of Ophthalmology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

DOI: 10.36347/sjams.2021.v09i12.031 | **Received:** 09.11.2021 | **Accepted:** 20.12.2021 | **Published:** 30.12.2021

***Corresponding author:** Dr. A.K.M. Mamunur Rahman
Associate Professor, Department of Ophthalmology, Jahurul Islam Medical College, Kishoreganj, Bangladesh

Abstract **Original Research Article**

Background: Refractive errors and amblyopia are among the leading causes of avoidable visual impairment in children. Early detection through screening-based ophthalmic assessment is essential to prevent long-term visual disability, particularly in resource-limited settings. ***Methods:*** This clinic-based cross-sectional study was conducted at Jahurul Islam Medical College and Hospital, Kishoregonj, Bangladesh, from March 2017 to January 2018. All children below 15 years of age attending the ophthalmology outpatient department during the study period were included. Comprehensive ophthalmic evaluation was performed, including visual acuity assessment using a logMAR ETDRS chart and cycloplegic refraction. The presence of amblyopia and strabismus was documented and refractive errors were categorized according to type and severity. ***Results:*** A total of 600 children were evaluated. Hypermetropia was the most prevalent refractive error, affecting 498 children (83.0%). Moderate hypermetropia (3.00–6.00 DS) was the most common subtype (33.0%), followed by mild (30.5%) and high hypermetropia (19.5%). Myopia was observed in 80 children (13.3%), while mixed astigmatism was identified in 22 children (3.6%). Among amblyopic children, compound hypermetropic astigmatism was the predominant refractive error, both in the absence and presence of strabismus. Esotropia was more commonly associated with amblyopia than exotropia. ***Conclusion:*** Hypermetropia and compound hypermetropic astigmatism were the most common refractive errors detected and were strongly associated with amblyopia. Screening-based ophthalmic assessment is effective in identifying amblyogenic refractive errors and should be emphasized for early intervention to prevent childhood visual impairment.

Keywords: Refractive errors; Amblyopia; Vision screening; Children; Hypermetropia.

INTRODUCTION

Visual impairment in childhood is a significant public health concern, particularly in low- and middle-income countries, where access to early eye care services remains limited [1]. Refractive errors and amblyopia are among the most common and preventable causes of visual impairment in children, yet they frequently remain undetected during early life [2]. If not identified and managed in a timely manner, these conditions can adversely affect a child's visual development, educational performance, psychosocial well-being and long-term quality of life [3].

Refractive errors including hypermetropia, myopia and astigmatism account for a substantial proportion of visual morbidity in the pediatric age group [4]. Hypermetropia is particularly common in younger children and may remain asymptomatic, while uncorrected myopia and significant astigmatism can lead to blurred vision and visual discomfort [5]. Persistent uncorrected refractive errors during the critical period of visual development may result in amblyopia, a condition characterized by reduced visual acuity that cannot be explained by structural ocular abnormalities alone. Amblyopia remains a leading cause of monocular visual

impairment in children and young adults worldwide [6].

Early detection through vision screening programs is widely recognized as an effective strategy for identifying refractive errors and amblyopia before irreversible visual loss occurs [7]. Screening-based assessments conducted in eye care facilities provide valuable epidemiological data and reflect real-world clinical presentations, particularly in settings where community-based screening programs are not yet well established [8]. Such facility-based studies also help in understanding patterns of refractive errors and their association with amblyopia and other ocular conditions, including strabismus [9].

In developing countries, childhood eye health has often received less priority compared to adult ocular diseases, despite the long-term burden associated with childhood visual impairment [10]. Data on the distribution of refractive errors and amblyopia among children attending eye care facilities remain limited, especially outside major urban centers. Generating local evidence is essential for planning targeted screening strategies, optimizing resource allocation and improving early referral and treatment services [11].

Against this background, the present study was undertaken to assess the pattern of refractive errors and the occurrence of amblyopia among children attending an eye care facility, using a screening-based approach. By documenting the distribution of refractive error subtypes and their relationship with amblyopia, this study aims to contribute baseline data relevant to pediatric eye care planning and emphasizes the importance of early detection and intervention to prevent avoidable childhood visual impairment.

METHODOLOGY & MATERIALS

This clinic-based cross-sectional study was conducted at Jahurul Islam Medical College and Hospital, Kishoregonj, Bangladesh, from March 2017 to January 2018. During the study period, all children below 15 years of age attending the ophthalmology outpatient department were included. Informed consent was obtained from the parents or legal guardians of all participating children.

All enrolled children underwent a comprehensive ophthalmic examination, which included a detailed history of ophthalmic complaints, assessment of uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) using a logMAR ETDRS chart and objective and subjective refraction. To eliminate the effect of accommodation on refractive measurements, cycloplegic refraction was performed using 1% cyclopentolate.

During ophthalmic evaluation, the presence or absence of amblyopia and strabismus was recorded. All clinical findings were entered into a computerized proforma for subsequent analysis.

For the purpose of this study, normal visual acuity was defined as an uncorrected visual acuity equal to or better than 0.3 logMAR in the better eye. Amblyopia was defined as an initial BCVA of 0.20 logMAR or worse, with at least a two-line difference on the logMAR chart between the amblyopic and fellow eye, in the absence of any detectable ocular pathology in either eye. Strabismus was diagnosed in the presence of an intermittent or constant horizontal deviation of ≥10 prism diopters (PD), a vertical deviation of ≥3 PD, or other associated ocular motility disorders.

Children were categorized based on refractive status as myopic (refractive error > −0.50 diopters sphere [DS]) or hypermetropic (refractive error > +0.50 DS). Both myopia and hypermetropia were further subdivided into mild (≤3.00 DS), moderate (3.00–6.00 DS) and high (>6.00 DS) based on the spherical equivalent.

Refractive errors were classified as simple myopia or simple hypermetropia when not associated with astigmatism. Compound astigmatism was categorized into compound myopic astigmatism and compound hyperopic astigmatism. Each type of compound astigmatism was further graded as mild (0.50–1.00 DS), moderate (1.25–2.50 DS), or high (>2.00 DS).

RESULTS

From March 2013 to July 2013, a total of 1350 children presented at the center. The mean age of the children was 7.6 years (±3.64 years) with an age range of 1-15 years. Of the 1350 children, a total of 600 (44.4%) were found to have refractive errors of which 51% were males.

Table 1: Distribution of RE subtypes

Refractive Error	Number of Patients n (%)	Sub-groups of RE (DS)	Number of Patients n (%)
Hypermetropia	498 (83.0)	< 3.00	183 (30.5)
		3.00–6.00	198 (33.0)
		> 6.00	117 (19.5)
Myopia	80 (13.3)	< 3.00	28 (4.6)
		3.00–6.00	34 (5.6)
		> 6.00	18 (3.0)
Mixed Astigmatism	22 (3.6)		

Total	600		

DS: Diopters; RE: Refractive errors

Table 1 shows hypermetropia was the most prevalent refractive error, affecting 498 children (83.0%). Within the hypermetropic group, moderate hypermetropia (3.00–6.00 DS) was the most common, observed in 198 children (33.0%), followed by mild hypermetropia (<3.00 DS) in 183 children (30.5%) and high hypermetropia (>6.00 DS) in 117 children (19.5%). Myopia was detected in 80 children (13.3%), of whom 34 (5.6%) had moderate myopia, 28 (4.6%) had mild myopia and 18 (3.0%) had high myopia. Mixed astigmatism was identified in 22 children (3.6%).

Table 2: Distribution of refractive error among amblyopic children in relation to presence and type of associated strabismus

Refractive Error Type	No Squint n (%)	With ET n (%)	With XT n (%)
Simple Hypermetropia	1 (1.7%)	1 (1.7%)	0 (0.0%)
Compound Hypermetropic Astigmatism 1.00 DC	7 (12.2%)	9 (15.7%)	0 (0.0%)
Compound Hypermetropic Astigmatism 1.25–2.50 DC	13 (23.0%)	11 (19.2%)	1 (1.7%)
Compound Hypermetropic Astigmatism >2.50 DC	6 (10.5%)	5 (8.7%)	0 (0.0%)
Mixed Astigmatism	1 (1.7%)	0 (0.0%)	2 (3.5%)

Among amblyopic children, compound hypermetropic astigmatism was the most frequently observed refractive error, both in the absence and presence of strabismus. In children without squint, compound hypermetropic astigmatism of 1.25–2.50 DC was the most common (13, 23.0%), followed by 1.00 DC (7, 12.2%) and >2.50 DC (6, 10.5%), while simple hypermetropia and mixed astigmatism were each present in 1 child (1.7%). Among amblyopic children with esotropia, compound hypermetropic astigmatism of 1.00 DC (9, 15.7%) and 1.25–2.50 DC (11, 19.2%) predominated, whereas fewer cases were observed with higher astigmatic power (>2.50 DC; 5, 8.7%) and simple hypermetropia (1, 1.7%). Exotropia was uncommon among amblyopic children and was mainly associated with compound hypermetropic astigmatism of 1.25–2.50 DC (1, 1.7%) and mixed astigmatism (2, 3.5%) (Table 2).

DISCUSSION

This screening-based, facility-centered study highlights the burden and pattern of refractive errors and amblyopia among children attending an eye care facility. In the present study, hypermetropia was the most prevalent refractive error, affecting 83.0% of children, with moderate hypermetropia (3.00–6.00 DS) being the most common subtype (33.0%). These findings are consistent with reports from pediatric screening programs that indicate hypermetropia as a dominant refractive condition in younger age groups, particularly in clinical and screening-based settings [12, 13]. The high proportion of moderate-to-high hypermetropia observed in our study is clinically important, as uncorrected hypermetropia is a well-recognized risk factor for amblyopia and strabismus.

Myopia accounted for 13.3% of refractive errors in our cohort, with moderate myopia being slightly more common than mild and high myopia. This proportion is comparable to findings from other pediatric screening studies, which have reported lower prevalence of myopia compared to hypermetropia in younger children attending eye care facilities [14, 15]. Differences in refractive error patterns across studies may be explained by variations in age distribution, ethnicity, screening methodology and study setting, as noted by Tarczy-Hornoch et al. in large population-based pediatric eye disease studies [16].

A key finding of the present study is the strong association between amblyopia and compound hypermetropic astigmatism. Among amblyopic children without strabismus, compound hypermetropic astigmatism of 1.25–2.50 DC was the most frequent refractive error (23.0%), followed by lower and higher degrees of astigmatism. Similar patterns were also observed among amblyopic children with esotropia, where compound hypermetropic astigmatism remained the predominant refractive error. These findings align with previous studies demonstrating that uncorrected astigmatism and hypermetropic refractive errors are major contributors to amblyopia development [17, 18].

The predominance of esotropia among amblyopic children with strabismus in our study further supports existing evidence that hypermetropia and accommodative mechanisms play a significant role in the development of convergent strabismus and subsequent amblyopia. Horwood and Riddell reported that hypo-accommodative responses in hypermetropic children increase the risk of both strabismus and amblyopia, emphasizing the importance of early detection and optical correction [19]. In contrast, exotropia was relatively uncommon in our cohort and was mainly associated with mixed astigmatism and moderate compound hypermetropic astigmatism, a pattern also noted in other pediatric amblyopia studies [20].

The findings of this study reinforce the value of screening-based vision assessment in identifying clinically significant refractive errors and amblyopia at an early stage. Griffith et al. demonstrated the

effectiveness of large-scale screening programs in detecting visual abnormalities in children, while Arnold and Kassem emphasized that early screening remains one of the most effective strategies for amblyopia prevention [12, 20, 21]. Our results further support these observations by showing that a substantial proportion of children attending an eye care facility harbor refractive errors with amblyogenic potential.

From a public health perspective, the high burden of hypermetropia and amblyopia observed in this study underscores the need for strengthening pediatric vision screening services, particularly in resource-limited settings. Early identification followed by appropriate spectacle correction and amblyopia management can significantly reduce long-term visual disability, as highlighted by Leat et al. and Manny et al [22, 23]. Furthermore, improving parental awareness and compliance with spectacle use is crucial, as poor adherence remains a barrier to successful visual rehabilitation [24].

Limitations of the study

This study has some limitations. Being a clinic-based cross-sectional study, the findings may not be representative of the general pediatric population, as children attending an eye care facility are more likely to have visual complaints. The cross-sectional design also limits the ability to establish causal relationships between refractive errors, amblyopia and strabismus. Additionally, follow-up outcomes after refractive correction or amblyopia treatment were not assessed, which could have provided further insight into visual improvement following early detection.

CONCLUSION

In conclusion, this study demonstrates that hypermetropia particularly moderate degrees and compound hypermetropic astigmatism are the predominant refractive errors among children attending an eye care facility and are strongly associated with amblyopia, with or without strabismus. These findings emphasize the importance of routine screening-based ophthalmic evaluation in children to ensure timely detection and intervention, thereby preventing avoidable childhood visual impairment.

Financial support and sponsorship: No funding sources.

Conflicts of interest: There are no conflicts of interest.

REFERENCES

1. Mathers M, Keyes M, Wright M. National Children's Vision Screening Project. Literature Rev. 2008 Jul 31:10-29.
2. Carlton J, Czoski-Murray C. The value of screening for amblyopia revisited. InPediatric Ophthalmology, Neuro-Ophthalmology, Genetics: Strabismus-New Concepts in Pathophysiology, Diagnosis and Treatment 2010 (pp. 95-111). Berlin, Heidelberg: Springer Berlin Heidelberg.
3. Lola Solebo A, Rahi JS. Vision screening in children: why and how?. Ophthalmic epidemiology. 2014 Aug 1;21(4):207-9.
4. Ugurbas SC, Alpay A, Tutar H, Sagdik HM, Ugurbas SH. Validation of plusoptiX S04 photoscreener as a vision screening tool in children with intellectual disability. Journal of American Association for Pediatric Ophthalmology and Strabismus. 2011 Oct 1;15(5):476-9.
5. Bregman J, Donahue SP. Validation of photoscreening technology in the general pediatrics office: a prospective study. Journal of American Association for Pediatric Ophthalmology and Strabismus. 2016 Apr 1;20(2):153-8.
6. Carlton J, Czoski-Murray C. Screening for amblyopia and strabismus in children aged 4–5 years: where do we go from here?. British and Irish Orthoptic Journal. 2009 Aug 1;6.
7. Le TD, Raashid RA, Colpa L, Noble J, Ali A, Wong A. Paediatric vision screening in the primary care setting in Ontario. Paediatrics & child health. 2018 May 11;23(3):e33-9.
8. Kemper AR, Keating LM, Jackson JL, Levin EM. Comparison of monocular autorefraction to comprehensive eye examinations in preschool-aged and younger children. Archives of pediatrics & adolescent medicine. 2005 May 1;159(5):435-9.
9. Kedir J, Girma A. Prevalence of refractive error and visual impairment among rural school-age children of Goro District, Gurage Zone, Ethiopia. Ethiopian journal of health sciences. 2014 Nov 4;24(4):353-8.
10. Elsner AE, King BJ. Screening for macular disorders: the optometrist's perspective. Clinical Optometry. 2015 Mar 18:15-38.
11. Sabri K, Thornley P, Waltho D, Warren T, Laverty L, Husain S, Farrokhyar F, Higgins D. Assessing accuracy of non–eye care professionals as trainee vision screeners for children. Canadian Journal of Ophthalmology. 2016 Feb 1;51(1):25-9.
12. Griffith JF, Wilson R, Cimino HC, Patthoff M, Martin DF, Traboulsi EI. The use of a mobile van for school vision screening: results of 63 841 evaluations. American journal of ophthalmology. 2016 Mar 1;163:108-14.
13. Alley CL. Preschool vision screening: update on guidelines and techniques. Current Opinion in Ophthalmology. 2013 Sep 1;24(5):415-20.
14. Bruce A, Santorelli G, Wright J, Bradbury J, Barrett BT, Bloj M, Sheldon TA. Prevalence of and risk factors for, presenting visual impairment: findings from a vision screening programme based on UK NSC guidance in a multi-ethnic population. Eye. 2018 Oct;32(10):1599-607.
15. Dhanesha U, Polack S, Bastawrous A, Banks LM. Prevalence and causes of visual impairment among schoolchildren in Mekelle, Ethiopia. Cogent medicine. 2018 Jan 1;5(1):1554832.

16. Tarczy-Hornoch K, Varma R, Cotter SA, McKean-Cowdin R, Lin JH, Borchert MS, Torres M, Wen G, Azen SP, Tielsch JM, Friedman DS. Risk factors for decreased visual acuity in preschool children: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. Ophthalmology. 2011 Nov 1;118(11):2262-73.
17. Hashemi H, Yekta A, Jafarzadehpur E, Ostadimoghaddam H, Asharlous A, Nabovati P, Khabazkhoob M. Sensitivity and specificity of preschool vision screening in Iran. Iranian Journal of Public Health. 2017 Feb;46(2):207.
18. Shoshi MH, Shoshi A, Agim X, Fitore S, Fjolla S, Flaka S. Amblyopia In Children 3-9 Years Old, With Refractive Anomalies During 2010-2011 In Prishtina. Int J Oph-thalmol Eye Res. 2014 Jul 26;2(4):39-48.
19. Horwood AM, Riddell PM. Hypo-accommodation responses in hypermetropic infants and children. British journal of ophthalmology. 2011 Feb 1;95(2):231-7.
20. Arnold RW. Towards worldwide amblyopia elimination–vision screening. European Ophthalmic Review. 2009;2(1):91-8.
21. Kassem AM. Automated vision screening. Advances in Ophthalmology and Optometry. 2018 Aug 1;3(1):87-100.
22. Leat SJ. To prescribe or not to prescribe? Guidelines for spectacle prescribing in infants and children. Clinical and experimental Optometry. 2011 Nov 1;94(6):514-27.
23. Manny RE, Sinnott LT, Jones-Jordan LA, Messer D, Twelker JD, Cotter SA, Kleinstein RN, Crescioni M, CLEERE Study Group. Predictors of adequate correction following vision screening failure. Optometry and Vision Science. 2012 Jun 1;89(6):892-900.
24. Kodjebacheva GD, Maliski S, Coleman AL. Use of eyeglasses among children in elementary school: perceptions, behaviors and interventions discussed by parents, school nurses and teachers during focus groups. American Journal of Health Promotion. 2015 May;29(5):324-31.