Ophthalmologica Indonesiana
Vol. 52 No. 1 2026, 1-8
E-ISSN: 2460-545X | P-ISSN: 0126-1193
Publisher: Perhimpunan Dokter Spesialis Mata Indonesia (PERDAMI)

Original Article

Refractive Status Characteristic in School-Aged Children: Cicendo National Eye Hospital Vision Screening Program

Nathasya Maharani Susilo[1], Nina Ratnaningsih[2], Mayang Rini[3]

[1]Department of Ophthalmology, Faculty of Medicine, Padjadjaran University, Bandung, Indonesia
[2]Department of Ophthalmology, Faculty of Medicine, Padjadjaran University, Bandung, Indonesia; National Eye Center, Cicendo Eye Hospital, Bandung, Indonesia
[3]Department of Ophthalmology, Faculty of Medicine, Padjadjaran University, Bandung, Indonesia; National Eye Center, Cicendo Eye Hospital, Bandung, Indonesia
Corresponding email: thasyamsusilo@gmail.com

ARTICLE INFO

Article History
Received : 06-08-2024
Revised : 30-12-2025
Accepted : 14-02-2026

Keywords
Refractive Error
Screening
School screening program

Acces this article online

https://doi.org/10.35749/journal.v52i1.101736

Quick Response Code:

ABSTRACT

Introduction: Refractive error often leads to visual impairment if left untreated. Vision screening is considered effective in detecting and treating refractive errors in children. Through this screening, we can determine how many school-aged children experience refractive errors and provide earlier management. This study aims to describe the characteristics of refractive error status of school-age children included in the vision screening program by the community ophthalmology unit, National Eye Center Cicendo Eye Hospital. Methods: This retrospective cross-sectional study from data collection of documentation of school-age children in the vision screening program from January – December 2023. Exclusion criteria included children who have other ocular abnormalities and those with incomplete data. The trainee, optometrist, and ophthalmologist measured visual acuity and non-cycloplegic refraction. Data processing and analysis were performed using Microsoft® Excel software. This study presents the distribution of refractive errors based on visual acuity, diagnosis, and age. Results: A total of 1411 children were included in this study. There were 488 (17%) children with visual impairment. The most common refractive error was myopia (395 eyes). Severe visual impairment (1,02%) was still found for best corrected visual acuity. Mild Myopia (259 eyes) and moderate astigmatism (176 eyes) become the common type of refractive error. Most students of 11 years old (26%) have refractive error. Conclusion: The prevalence of refractive error in school-age children is still high. Myopia was the most common refractive error. The majority of children with refractive error were 11 years old. Vision screening programs still need to be routinely performed.

Introduction

Visual impairment in children is a global health issue. Uncorrected refractive errors are a major cause of visual impairment in children. The World Health Organization (WHO) reports that there are 2.2 billion people worldwide with visual impairments, including 19 million children. Among these, 12.8 million children have visual impairments due to uncorrected refractive errors. In Indonesia, Refractive errors among school-aged children are still reported at 25%, with 66 million children yet to be corrected. Halim et al. reported that in 2020, there were 484 school-aged children in Bandung with refractive errors, 70% of whom were not corrected.[1–4]

Uncorrected refractive errors in children can impact various aspects of their lives. Visual impairment can affect effective learning activities at school, leading to a decline in academic performance. It can also influence their daily activities and potentially reduce their quality of life and social development. Prompt and accurate detection and management are necessary to address these issues before they become significant problems.[5–7]

Method

This study was conducted with a retrospective cross-sectional design. Research data were obtained from the documentation of refractive screening results by the Community Ophthalmology Unit at the National Eye Center Cicendo Eye Hospital from January to December 2023. The data collected included age, gender, visual acuity, refractive error corrections, and diagnoses. Inclusion criteria for this study were all school-aged children aged 6-15 years who underwent refractive error screening by the Community Ophthalmology Installation at the National Eye Center Cicendo Eye Hospital. Exclusion criteria included patients with other eye diseases and incomplete data.

Examination Technique

Visual acuity was measured using a tumbling E chart at a distance of six meters and was measured by trainee, optometrist, and ophthalmologist. The charts used had sizes of 6/60, 6/18, and 6/12. The examination was conducted simultaneously for 5-10 children in a single round of screening. The acuity measured was presenting visual acuity (PVA). Children who already wore glasses continued to use them during the examination. Measurement was performed alternately on each eye. Each child was asked to identify the direction of the tumbling E four times for each card size until the smallest card size was reached.

Each child who could not correctly identify the direction of the tumbling E in at least three out of four measurements would undergo subjective and objective refractive error correction assessments. Objective examination was performed using an autorefractor, and subjective assessment was conducted using the ETDRS chart at a distance of four meters. The correction provided was based on the results of the objective examination.

Measurement of visual acuity and refractive error correction was performed without cycloplegia. Ocular examination was conducted using a flashlight. Children who did not achieve optimal correction or who had ocular abnormalities were referred to an ophthalmologist for further evaluation.

Definition

Visual status is defined according to WHO categories. Normal vision is defined as visual acuity ≥6/12. Mild visual impairment is defined as visual acuity <6/12 to ≥6/18. Moderate visual impairment is defined as visual acuity <6/18 to ≥6/60. Severe visual impairment is defined as visual acuity <6/60 to 3/60. Blindness is defined as visual acuity <3/60.[3,11]

Children with visual impairment who receive correction will be categorized based on their refractive error diagnosis. There are three refractive error diagnosis: myopia simplex, hyperopia simplex, and astigmatism. Astigmatism is further divided into astigmatism simplex, compound myopic astigmatism, and compound hypermetropic astigmatism.[12,13]

Myopia is classified based on the spherical equivalent (SE) obtained as follows: mild (SE ≤ -0.50 diopters (D) to ≥ -3.00 D), moderate (SE < -3.00 D to ≥ -6.00 D), and severe (SE > -6.00 D). Hyperopia is classified based on SE as follows: mild (SE ≥ +0.50 D to < +2.00 D), moderate (SE > +2.00 D to ≤ +5.00 D), and severe (SE > +5.00 D). Astigmatism is classified as mild (cylindrical (cyl) -0.25 to ≥ -1.00 D), moderate (cyl < -1.00 to ≥ -2.50 D), and high (cyl > -2.50 D). The spherical equivalent is calculated by adding the spherical value to half the cylindrical value.[11,13] Data processing and analysis were performed using Microsoft® Excel software and presented in table format.

Results and Discussion

Results

The refractive status screening program was conducted at five elementary schools and one junior high school in Bandung and its surrounding areas from January to December 2023.

Twenty-three children were excluded from the study due to other ocular abnormalities and incomplete documentation. A total of 1,411 children (2822 eyes) were included in the sample for this study. The demographic characteristics of the patients are displayed in Table 1. Among those examined, 49% were boys and 51% were girls. The most common age among subjects was 12 years (23%).

Table 1. Demographic Characteristic

Characteristic	Total (n=1411)
Sex	
Male	695 (49%)
Female	716 (51%)
Age	
6	3 (0.2%)
7	115 (8.2%)
8	118 (8.4%)
9	192 (14%)
10	231 (16%)
11	214 (15%)
12	323 (23%)
13	209 (15%)
14	5 (0.4%)
15	1 (0.1%)
School	
SDN 006 Buah Batu	414 (29.3%)
SDN 270 Gentra	571 (40.5%)
SDN 184 Kota Bandung	40 (2.8%)
SDN 261 Margahayu Raya	84 (6.0%)
SMP 2 Cimahi	302 (21.4%)

Note = n: number of children; SDN: Elementary school

Ophthalmologica Indonesiana
Vol. 52 No. 1 2026, 1-8

Visual status characteristics are displayed in Table 2. Normal visual status was found in 2,333 (83%) eyes. Visual impairment was found in 489 (17%) eyes. Myopia simplex (MS) was diagnosed in 172 (6.1%) eyes, hyperopia simplex (HS) was not found in this study, and astigmatism was found in 317 (11.2%) eyes. Compound myopic astigmatism was diagnosed in 223 eyes.

The visual acuity, both PVA and with correction, is detailed in Table 3. PVA revealed 233 eyes (8.08%) in the mild category, 141 eyes (4.89%) in the moderate category, 96 eyes (3.33%) in the severe category, and 18 eyes (0.62%) in the blindness category. With correction, 5 eyes (1.02%) were in the severe category, 3 eyes (0.61%) in the moderate category, 49 eyes (10.04%) in the mild category, and 431 eyes (88.32%) in the normal category. No eyes with correction were found in the blindness category.

Table 2. Characteristic of Visual Status

Characteristic	n (%)
Visual Status	**2822 (100%)**
Normal	2333 (83%)
Vision Impairment	489 (17%)
Refractive Error	**489 (100%)**
MS	172 (6.1%)
HS	0 (0%)
Astigmatism	317 (11.2%)
AS	68 (21.5%)
AMK	223 (70.3%)
AHK	26 (8.2%)

Note= n: number of eyes; MS: Myopia simplex; HS: Hyperopia simplex; AS: Astigmatism simplex; AMK: Compound myopia astigmatism; AHK: Compound hypermetropia astigmatism

The distribution of refractive errors based on diagnosis categories is shown in Figure 1. Low myopia is the most prevalent category of refractive error among school-aged children, with 259 eyes affected. Moderate astigmatism is the second most common category, with 176 eyes. Hyperopia was found in only 26 eyes, with the majority being mild hyperopia (16 eyes). The distribution of refractive errors by age is shown in Figure 2. Refractive errors were most commonly found in children aged 11 years, accounting for 16%, and least commonly in those aged 15 years, accounting for 0.2%.

Table 3. Distribution of Visual Impairment Categories Based on Visual Acuity

Visual Impairment	*Presenting Visual Acuity*	With Correction
Blindness	18 (0.64%)	0 (0%)
Severe	96 (3.40%)	5 (1.02%)
Moderate	142 (5.03%)	3 (0.61%)
Mild	233 (8.28%)	49 (10.04%)
Normal	2333 (82.67%)	432 (88.34%)
Total (n)	**2822 (100%)**	**489(100%)**

note= n: number of eyes

Discussion

The prevalence of refractive errors in school-aged children varies. In this study, 17% of children were found to have visual impairment due to refractive errors. Some studies report different prevalence rates. Hassan et al. reported that 20% of children in Baramulla, India, have refractive errors. Ramirez-Ortiz et al. reported that 31.2% of

school-aged children in Mexico have refractive errors. In contrast, Bist et al. reported that 8.4% of school-aged children in Nepal have refractive errors. These differences in prevalence percentages are likely due to variations in sampling methods, sample population sizes, geographic differences, and living areas.[14–17]

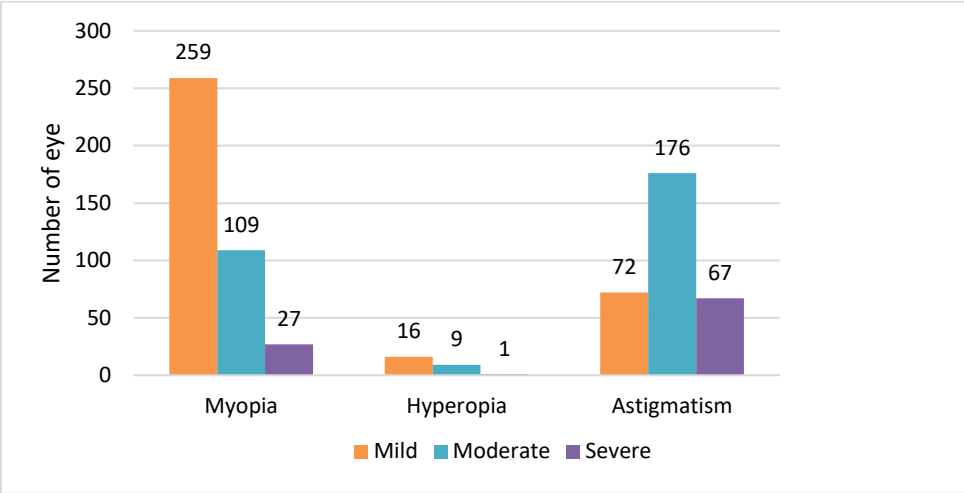

Figure 1. Distribution of Refractive Errors Based on Diagnosis

This study reports that 1.02% of children still fall into the category of severe visual impairment and 10.04% into mild visual impairment after correction. In contrast, Sharma et al. reported that in Bhutan, 13% were classified with mild visual impairment, 4% with moderate visual impairment, and none with severe visual impairment or blindness. The high percentage of visual impairment due to uncorrected refractive errors indicates that refractive errors remain a significant issue causing visual impairment in school-aged children. Various preventive strategies still need to be improved.[10,18,19]

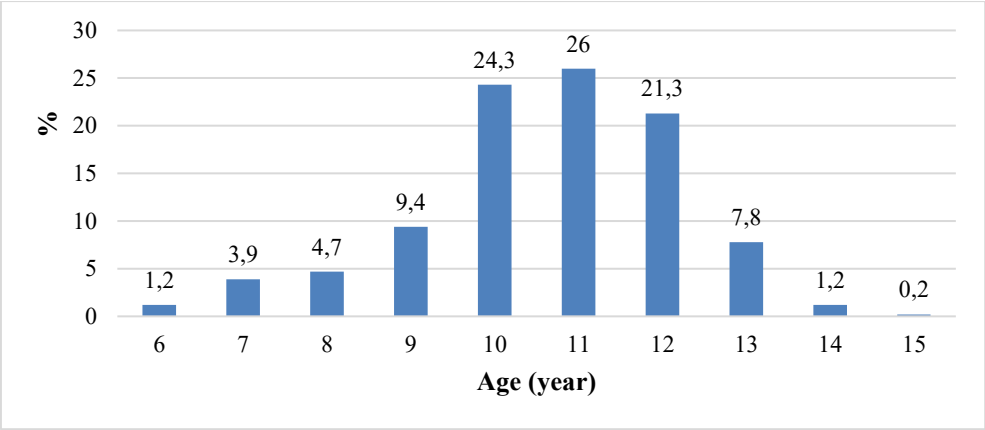

Figure 2. Distribution of Refractive Errors Based on Age

Refractive errors in children change with age. Changes in the axial length of the eye are one factor influencing these changes in refractive errors. The process of emmetropization typically concludes by age 7. After age 8, children's eyes may experience a myopic shift due to the elongation of the axial length of the eye. Cao et al. report that the prevalence of visual impairment increases at ages 11-12. Wong et

al. found that in Shandong, China, the highest prevalence of refractive errors was in children aged 8-11 years. Ahmed et al. reported that myopia was most common at age 15 and least common at age 6.[7,12,20,21] This is similar to the findings in this study, where the highest prevalence of refractive errors was observed in 11-year-olds (26%). The low percentage at age 15 (0.2%) is likely due to the small number of subjects in that age group.

The World Health Organization estimates that half of the global population will be myopic by 2050. This is consistent with the findings of this study, where low myopia was found in 259 eyes, followed by moderate astigmatism in 176 eyes. Bhutia et al. also reported that myopia was predominant in 335 children, followed by astigmatism in 317 children. Wang et al. noted that the school-age period is particularly vulnerable to myopia progression. School-aged children are also exposed to risk factors that can accelerate myopia progression. High myopia poses a significant risk for vision impairment and other ocular comorbidities. Cao et al. mentioned that astigmatism also requires more attention as it is more likely to cause vision problems such as amblyopia. Tang et al. noted that the high prevalence of astigmatism is partly influenced by race. Asia has been reported to have a higher prevalence of astigmatism due to anatomical differences in the eyes of this racial group.[3,7,17,22,23]

This study reported that only 26 children had hyperopia, with the majority being mild hyperopia (16 children). Cycloplegic refraction is the gold standard for assessing refractive errors in children. Given the high accommodation ability in children, cycloplegic refraction is recommended for evaluating refractive errors in this age group. Cycloplegic refraction helps to identify latent hyperopia. The low prevalence of hyperopia in this study is suspected to be due to the lack of cycloplegic examination during the refractive assessment.[11–13]

This study has several limitations including the absence of cycloplegic refraction, which is considered the gold standard for measuring refractive errors in children. As a retrospective study, it also encountered challenges with incomplete data, such as a lack of information on the history of eyeglass use. Additionally, the study did not explore potential risk factors for refractive errors, including socioeconomic status, parental education, income, and occupation. Furthermore, it did not examine possible contributors to the prevalence of high myopia, such as genetic predisposition, time spent on near-work activities, or insufficient outdoor exposure. The uneven distribution of schools in Bandung and surrounding areas means that the prevalence results from this study may not accurately represent the population of the region.

The strengths of this study include a large sample size and age-specific insights that provide targeted data within a specific developmental stage of age. Suggestions for future research include calculating sample size and randomizing school selection to ensure representativeness of the population. The implementation of refractive error screening programs in Bandung and surrounding areas needs to be improved and carried out regularly to reduce the rates of visual impairment and blindness among children.

Conclusion

Approximately 17% of school-age children aged 6-15 years screened in this study had visual impairments. Despite correction, 1.02% of children still had severe visual impairments. The majority of children with refractive errors were 11 years old. Myopia was the most common refractive error (395 eyes), followed by astigmatism (317 eyes). It is recommended for future research to account for population size and use random sampling of schools to better represent the population. It is crucial to enhance and regularly conduct refractive error screening programs for children to address these issues effectively.

References

1. Sil A, Aggarwal P, Sil S, Mitra A, Jain E, Sheeladevi S, et al. Design and delivery of the Refractive Errors Among Children (REACH) school-based eye health programme in India. Clin Exp Optom. 2023 Nov 17;106(8):859–68.
2. Halim A, Suganda R, Sirait SN, Memed FK, Syumarti, Rini M, et al. Prevalence and associated factors of uncorrected refractive errors among school children in suburban areas in Bandung, Indonesia. Cogent Med. 2020 Mar 9;7(1).
3. World Health Organization. Blindness and Vision Impairment. 2023.
4. Arianingtyas NM, Triningrat AA, Utari NM, Sutyawan IW. Prevalensi Dan Karakteristik Kelainan Refraksi Pada Anak Usia Remaja di SMP Negeri 3 Denpasar Pada Tahun 2021. Jurnal Media Udayana. 2022;
5. Da Silva K, Dowell M, Savatovsky EJ, Grosvenor D, Callender D, Campbell MH, et al. The Burden of Pediatric Visual Impairment and Ocular Diagnoses in Barbados. Int J Environ Res Public Health. 2023 Aug 10;20(16):6554.
6. Saiyang B, Rares LM, Supit WP. Kelainan Refraksi Mata pada Anak. Medical Scope Journal. 2021 Jan 8;2(2).
7. Cao H, Cao X, Cao Z, Zhang L, Han Y, Guo C. The prevalence and causes of pediatric uncorrected refractive error: Pooled data from population studies for Global Burden of Disease (GBD) sub-regions. PLoS One. 2022 Jul 1;17(7):e0268800.
8. World Health Organization. Vision and Eye Screening Implementation Handbook. 2023.
9. Ministry of Health of Indonesia. The Road Map of Visual Impairment Control Program in Indonesia 2017-2030. 2018;
10. Maduka-Okafor FC, Okoye O, Ezegwui I, Oguego NC, Okoye OI, Udeh N, et al. Refractive Error and Visual Impairment Among School Children: Result of a South-Eastern Nigerian Regional Survey. Clinical Ophthalmology. 2021 Jun;Volume 15:2345–53.
11. American Association for Pediatric Ophthalmology and Strabismus AA of O. Vision Screening for Infants and Children. In 2022.
12. Khan A, Ta Chen P, Chang C, El-Dairi MA, Lee KA, Miraldi Utz V, et al. Basic and Clinical Science Course, Section 6: Pediatric Ophthalmology and Strabismus. 2023.
13. Brodie SE, Ang M, Irsch K, Jackson M Lou, Mauger TF, Oostra T. Basic and Clinical Science Course TM 3 Clinical Optics and Vision Rehabilitation. 2023.
14. Hassan S, Nabi S, Zahoor N, Khan S, Makayee AA, Wahab A. Prevalence and pattern of refractive errors among school-going children in district Baramulla,

Kashmir: A cross sectional study. Indian J Ophthalmol. 2023 Dec;71(12):3642–5.
15. Ramírez-Ortiz MA, Amato-Almanza M, Romero-Bautista I, Klunder-Klunder M, Aguirre-Luna O, Kuzhda I, et al. A large-scale analysis of refractive errors in students attending public primary schools in Mexico. Sci Rep. 2023 Aug 19;13(1):13509.
16. Bist J, Kandel H, Paudel N, Kaphle D, Gyawali R, Marasini S, et al. Prevalence of refractive errors in Nepalese children and adults: a systematic review with meta-analysis. Clin Exp Optom. 2023 Feb 17;106(2):119–32.
17. Tang Y, Chen A, Zou M, Liu Z, Young CA, Zheng D, et al. Prevalence and time trends of refractive error in Chinese children: A systematic review and meta-analysis. J Glob Health. 2021 Jul 17;11:08006.
18. Sharma IP, Lepcha NT, Lhamo T, Ellwein LB, Pokharel GP, Das T, et al. Visual impairment and refractive error in school children in Bhutan: The findings from the Bhutan School Sight Survey (BSSS 2019). PLoS One. 2020 Sep 14;15(9):e0239117.
19. Ezegwui I, Oguego N, Okoye O, Maduka-Okafor F, Udeh N, Aghaji A, et al. Prevalence of refractive errors and visual impairment in school children in Enugu South-East Nigeria. Niger J Clin Pract. 2021;24(3):380.
20. Ahmed ZA, Alrasheed SH, Alghamdi W. Prevalence of refractive error and visual impairment among school-age children of Hargesia, Somaliland, Somalia. Eastern Mediterranean Health Journal. 2020 Nov 1;26(11):1362–70.
21. Wong SC, Kee CS, Leung TW. High Prevalence of Astigmatism in Children after School Suspension during the COVID-19 Pandemic Is Associated with Axial Elongation. Children. 2022 Jun 19;9(6):919.
22. Bhutia KL, Bhutia SC, Gupta N, Shenga DO. Prevalence of refractive errors among the school-going children in East Sikkim. Indian J Ophthalmol. 2021 Aug;69(8):2018–20.
23. Wang J, Li Y, Musch DC, Wei N, Qi X, Ding G, et al. Progression of Myopia in School-Aged Children After COVID-19 Home Confinement. JAMA Ophthalmol. 2021 Mar 1;139(3):293.