Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

Exploring visual functionality in school-going children (6-12 years) from urban and rural district of Pune

Susmita Banerjee[1]*, Renu Magdum[2], Veshal Madan[1], Madhura Gandhi[3]

[1]*Dr. D Y Patil Institute of Optometry & Visual Sciences, Pune, Maharashtra, India*
[2]*Dept. of Ophthalmology, D Y Patil Medical College & Research Centre, Pune, Maharashtra, India*
[3]*Dr. D. Y. Patil Medical College, Hospital & Research Centre, Pune, Maharashtra, India*

ARTICLE INFO

Article history:
Received 24-05-2024
Accepted 04-07-2024
Available online 30-12-2024

Keywords:
Refractive errors
Amplitude of accommodation
Visual acuity
Color vision
Refractive index

ABSTRACT

Background: This study examines visual impairments prevalence in Pune District's urban and rural school children, recognizing environmental influences on visual development. Understanding variations in visual metrics informs public health initiatives. Visual acuity and color vision play pivotal roles in academic and social development, highlighting the importance of targeted vision care strategies.
Clinical Relevance: This study emphasizes the importance of early detection and intervention for visual impairments in children, emphasizing the crucial role of clinical optometrists in conducting regular eye check-ups and collaborating with schools and parents.
Objective: "To compare visual functionality, in school-going children aged 6-12 years from urban and rural districts of Pune, aiming to identify potential disparities."
Materials and Methods: A cross-sectional study in Pune District evaluated 900 systematically selected school children (450 from urban, 450 from rural areas). Visual metrics were assessed: stereo acuity (Titmus test), amplitude of accommodation (RAF rule), refractive status (full spectacle correction), visual acuity (Snellen's chart), and color vision (Ishihara test). Statistical analysis employed descriptive statistics and chi-square tests.
Result: In a demographic study of 900 participants from 7 Taluka schools in Pune, Maval Taluka had the highest representation (17.9%). Prevalence of myopia was higher in urban (94.8%) than rural (70.7%) areas, while hypermetropia was more common in rural (29.3%) than urban (5.2%) areas. Color vision deficiencies exhibited no significant difference. Stereo acuity and amplitude of accommodation varied significantly geographically, with stereoacuity notably lower than refractive errors and amplitude of accommodation.
Conclusion: The study found lower stereoacuity than refractive errors and amplitude of accommodation, with significant differences between urban and rural children, suggesting environmental influences.

1. Introduction

Children's visual development is multifaceted, influenced by environmental, lifestyle, and hereditary factors. In the formative years, acquiring and enhancing visual skills significantly impacts academic and well-being. Geographical context, urban or rural, may shape visual development. Uncorrected refractive errors, including accommodative anomalies and near point vergence anomalies, impede stereopsis development, affecting binocular function and sensory fusion. Stereoacuity, reflecting binocularity, is crucial for depth perception.[1] The disparities between urban and rural environments encompasses living conditions, resource accessibility, and lifestyle choices which potentially impact children's eye health.[2,3] Urban areas often exhibit higher population

* *Corresponding author*.
E-mail address: mail2susmitabanerjee@gmail.com (S. Banerjee).

https://doi.org/10.18231/j.ijceo.2024.134

densities, increased screen exposure, and accessibility of better medical facilities, whereas rural areas may have lower population densities, limited healthcare accessibility, and unique visual stimuli from outdoor activities and agricultural practices.[4] Understanding these differences aids in identifying visual challenges and how lifestyle and environmental factors shape children's visual profiles.[5–7]

The visual system significantly influences school children's development and education, with visual perception being fundamental to learning. Good vision facilitates information absorption and processing, enhancing academic performance and overall well-being.[8] Regular eye exams, access to corrective eyewear, and instilling good eye care habits are crucial for children's visual health, underscoring the roles of parents, teachers, and healthcare professionals.[7–9]

Visual acuity, measuring the sharpness or clarity of vision, and color vision are vital components significantly impacting learning, academic performance, and overall well-being in children.[10] Cones in the eye enable color perception, with the brain interpreting various colors through cone interactions. Standardized screenings for visual acuity (Snellen notation) and color vision (Ishihara test) was conducted as a part of the school health program for 6-12-year-olds in urban and rural Pune. However, interpreting results for children with learning difficulties remains challenging due to developmental delays affecting vision examination performance.[11]

Children's ability to learn and navigate their environment is profoundly influenced by their vision. Impairments in visual acuity and color perception can detrimentally affect learning, social interactions, and overall quality of life. This study aims to assess the prevalence of visual impairments and color vision deficiencies in school-going children, understanding their potential implications for academic and social development. By comparing and analyzing visual acuity and color vision, this research aims to inform optimal visual health and support children's holistic development.[11,12]

This cross-sectional study investigates and compares key aspects of visual health in 6-12-year-old school children from urban and rural Pune. Focus areas include stereoacuity, accommodation amplitude, and refractive status, providing comprehensive insights into visual abilities. Thorough examination of these visual characteristics aims to elucidate urban-rural disparities in children's visual profiles, informing customized vision care programs to promote optimal visual health.

1.1. Problem statement

"Due to lack of comprehensive data comparing the visual acuity, color vision, and refractive status of school-going children between urban and rural areas. This knowledge gap hinders the development of effective eye health and policies for the specific needs of these populations."

2. Materials and Methods

Ethical clearance was obtained from the DR D Y Patil Vidyapeeth Ethical Committee (Ref no: DYPV/EC/289/2019 dated June 6, 2019). Consent from parents was obtained for each child participating in the study. A total of 900 children aged 6 to 12 years were included (450 from each urban and rural area), considering a design effect of 2 for cluster sampling. Children with active ocular pathology, co-morbidities, or additional disabilities beyond visual impairment were excluded.

2.1. Study setting

A cross-sectional study was conducted in Pune District, Western Maharashtra, chosen for its demographic and socioeconomic diversity. Three urban and four rural areas were selected out of 14 talukas, considering sampling convenience to address potential disparities in healthcare access and eye health outcomes.

2.2. Data collection

Data collection occurred during school hours, utilizing portable equipment within each school's premises. Four testing stations were set up: history station for recording participant complaints, followed by stations for amplitude of accommodation, visual acuity, and near point of convergence (NPC) testing. Students started at the history station, where significant complaints were recorded alongside their record card.

2.3. Visual assessment

Stereo acuity was measured using the Titmus stereo test, and amplitude of accommodation was quantified using the RAF rule. Refractive status was determined with full spectacle correction. Amplitude of accommodation was measured binocularly using the 'push-up' method, employing a near-point target, occluder, and measuring device.

2.4. Visual acuity assessment

Visual acuity was assessed using Snellen's chart, a standardized tool comprising rows of symbols or characters in varying sizes. The chart was set 20 feet (6 meters) away from the test subject, and visual acuity was measured using the 20/20 standard for normal vision.

2.5. Data management and analysis

All data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0.

3. Results

3.1. Demographic study

In the demographic analysis of 450 participants from urban and rural areas, both groups were well-represented. Urban participants had a mean age of 8.38 years (SD=1.7), while rural participants had a mean age of 8.88 years (SD=1.50). Gender distribution showed 39.6% females and 60.4% males in urban areas, while rural areas had 45.6% females and 54.4% males. Anthropometric measures indicated urban participants were taller (151.19 ± 6.49 cm) and heavier (41.03 ± 9.48 kg) than rural participants (140.10 ± 12.19 cm; 33.30 ± 18.89 kg). Myopia prevalence was higher in urban (94.8%) than rural (70.7%) areas, while hypermetropia was more common in rural (29.3%) than urban (5.2%) areas. (Table 1)

3.2. Gender wise distribution

In the distribution of gender in urban and rural areas, in urban areas, there are 272 males, accounting for 60.44% of the population, and 178 females, making up 39.56%. In the rural areas have 245 males, constituting 54.44% of the population, and 205 females, representing 45.56%. (Table 2)

3.3. Taluka wise study

It is observed that in Beed Taluka 51 participants were from urban and 82 from rural area. In Haveli Taluka all the 86 participants were from Urban area, In Khed taluka 51 were from urban and 82 were from Rural area. In Maval taluka 62 participants were from Urban and 99 from rural area. In Mulshi taluka 58 were from Urban area and 93 from rural. In Pune City all the 84 participants were from urban area. In Velhe taluka 57 were from Urban and 94 from rural area. The taluka distribution based on geographical area is statistically insignificant.

3.3.1. Negative relative accommodation

It is observed that NRA minimum range was 6cm and maximum was 24 cm with mean of 8.93 and SD of +/- 2.42.

3.3.2. Positive relative accommodation

It is observed that PRA minimum range is 5 cm maximum of 24 cm with mean of 7.63 and SD of +/- 2.26.

3.3.3. Stereopsis

In the study of stereopsis it is observed that the minimum range of 0.22 and maximum of 1.82 with mean of 0.28 & SD of +/- 0.27.

3.3.4. Spectacle RX

In the study of spectacle RX it was observed that minimum range of – 4.00 maximum of 3.50 with mean of – 0.46 and SD of +/- 1.00. (Table 2)

3.4. Refractive errors in both eyes of the children's based on geographical area

In the study of refractive errors in both eyes of the children's based on geographical area was statistically significant.

3.5. Study of visual impairment

Statistical significance in both urban and rural populations regarding visual acuity suggests that there is a noteworthy and reliable difference or association related to visual acuity within both demographic groups. (Table 4)

The data or analysis conducted did not reveal any statistically relevant variation in color vision abilities between urban and rural populations, suggesting that this particular aspect of vision is similar in both the groups or is not influenced by the urban or rural environment.

In the study of binocular assessment in the urban area the positive fusional vergence patients were 12 and 20 in rural area. 5 negative fusional vergence was observed in urban area and 10 in rural area, 20 patients of heterophoria were observed in urban area and 32 in rural area. 12 patients with Near point of convergence were from urban area and 22 from rural area. In the study of Stereoacuity in both eyes of the individual based on geographical area is statistically significant. (Figure 2)

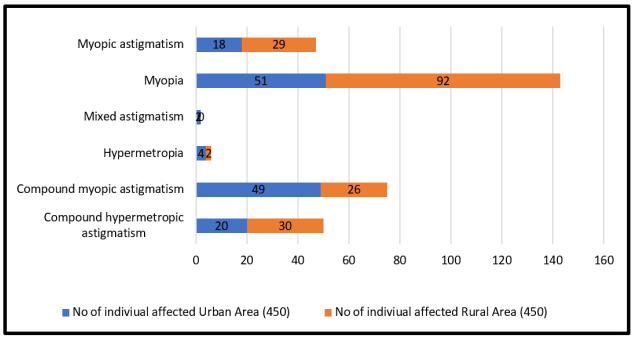

Figure 1: Refractive errors in both eyes of the children's based on geographical area

In the urban area, 78 individuals were affected by binocular Accommodative Amplitude (AA), while in rural areas, 95 individuals were affected. The difference in AA between urban and rural areas was found to be statistically significant, with a p-value of 0.022*.

For accommodative facility (AF) with ±2 lenses, 100 individuals were affected in urban areas compared to 110 in rural areas.

In terms of AF in the right eye, 105 individuals were affected in urban areas, while 128 were affected in rural areas.

Near point of accommodation (NRA) showed 25 affected individuals in urban areas and 34 in rural areas.

Table 1: Demographic study

Characteristics	Urban Area (450)	Rural Area (450)	P-Value
Age (in years)	8.38 ± 1.7	8.88 ± 1.50	
Female; N (%)	178 (39.6%)	205 (45.6%)	
Height (cms)	151.19 ± 6.49	140.10 ± 12.19	
Weight (Kg)	41.03 ± 9.48	33.30 ± 18.89	
B.M.I. (kg/m^2)	17.93 ± 3.66	16.23 ± 3.39	
NPA (in cm)	8.91 ± 2.46	8.95 ± 2.43	0.928
NPC (in cm)	8.37 ± 2.46	7.74 ± 2.19	< 0.001*
Stereopsis (inlogmar)	0.28 ± 0.27	0.28 ± 0.26	0.948

Values displayed are mean ± SD, test used: Mann-Whiteney U test. P-value < 0.05; statistically significant

Table 2: Gender distribution study

Gender	Urban		Rural		Total
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)	
Male	272	60.44	245	54.44	517
Female	178	39.56	205	45.56	383
Total	450	100	450	100	900

Table 3: Descriptive study of visual parameters in children's

Parameters	N	Minimum	Maximum	Mean	SD
NRA (in cm)	900	6	24	8.93	2.42
PRA (in cm)	900	5	24	7.63	2.26
Stereopsis (inlogmar)	900	0.22	1.82	0.28	0.27
Spectacle RX	900	-4	3.5	-0.46	1

Values displayed are mean and SD- Standard deviation

Table 4: Study of type of refractive error based on geographical area

Type of Refractive Error	Urban Area (115)	Rural Area (150)	P-Value
Myopia (215)	109 (94.8%)	106 (70.7%)	< 0.001*
Hypermetropia (50)	6 (5.2%)	44 (29.3%)	< 0.001*

Values displayed are frequency (%), test used: Chi-square test. P-value < 0.05; statistically significant

Similarly, positive relative accommodation (PRA) exhibited 29 affected individuals in urban areas compared to 32 in rural areas. (Table 5) (Figure 2)

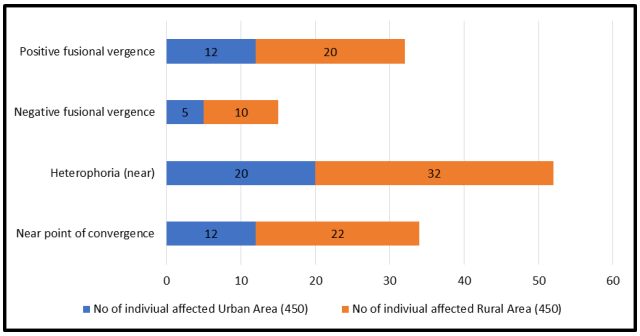

Figure 2: Binocular assessment in both eyes of the individual based on geographical area

The table presents a comparative analysis of accommodation parameters between urban and rural areas, each comprising 450 individuals. Notably, Binocular Accommodative Amplitude (AA) exhibited a significant difference, with 78 individuals affected in urban areas compared to 95 in rural areas (p = 0.022*). However, no statistical significance was observed for Accommodative Facility (AF) with ±2 lenses, AF in the right eye, Near Point of Accommodation (NRA), and Positive Relative Accommodation (PRA) between the two settings. In urban areas, AF with ±2 lenses affected 100 individuals, while in rural areas, 110 individuals were impacted. Similarly, AF in the right eye affected 105 individuals in urban areas and 128 in rural areas, while NRA affected 25 urban individuals and 34 rural individuals. PRA affected 29 individuals in urban areas and 32 in rural areas. These findings provide insights into the nuances of accommodation characteristics across urban and rural populations.(Table 6)

4. Discussion

In a comprehensive analysis of 900 school children, we investigated refractive errors, accommodative abnormalities, and stereoacuity across urban and rural areas.

Table 5: Study of visual impairment

Characteristics	Urban Area (450)	Rural Area (450)	P-Value
Visual Acuity	0.07 ± 0.14	0.02 ± 0.12	< 0.001*
	0.07 ± 0.13	0.02 ± 0.12	< 0.001*
Colour Vision	3.99 ± 0.09	3.99 ± 0.18	0.71
	3.99 ± 0.09	3.99 ± 0.11	0.415

Values displayed are frequency (%), test used: Chi-square test. P-value < 0.05; statistically significant represented by *

Table 6: Amplitude of accommodation in both eyes of the individual based on geographical area

Accommodation	No of individual affected		P value
	Urban Area (450)	Rural Area (450)	
AA (binocular)	78	95	
AF (binocular) with ± 2 lens	100	110	
AF (right eye)	105	128	0.022*
NRA	25	34	
PRA	29	32	

A significant finding was the lower stereoacuity compared to refractive errors and Amplitude of Accommodation. Myopia was prevalent in 215 children, with 94.8% from urban areas and 70.7% from rural areas. Hypermetropia affected 50 children, with 5.2% from urban and 29.3% from rural areas.

This study observed higher proportion of males in both urban and rural settings.

Additionally, our descriptive study revealed insights into visual parameters such as age distribution, where the majority (16.6%) were 9 years old, and a balanced male-to-female ratio of 1:1.16. Moreover, Maval taluka had the highest representation (17.9%) among the participants. Our findings suggest a correlation between vision impairments, particularly poor stereopsis, and refractive errors, echoing similar observations by Trachimowicz et al.,[11] indicating the impact of uncorrected myopia on stereoacuity.

In present study, we found that myopia, even at low levels (< -3 D), was associated with reduced stereoacuity as compared to emmetropia. Similar findings were reported by Ips et al.[12] and Kulp et al.,[13] who noted that moderate-to-severe hyperopia was significantly correlated with decreased stereoacuity. Interestingly, our study also revealed a higher prevalence of hyperopia-related reduced stereoacuity in both urban and rural areas, aligning with the findings of Kulp et al.[13] Additionally, we observed a higher incidence of heterophoria, particularly in rural areas as compared to urban population, possibly due to limited access to eye care services.

Refractive errors causing blur and decreased visual acuity were noted to impact stereoacuity, with even slight blurring affecting stereoscopic thresholds. Accommodative parameters varied between urban and rural populations, likely influenced by lifestyle, healthcare access, and environmental factors.

Moreover, higher levels of Near Point of Accommodation (NRA) and Positive Relative Accommodation (PRA) were observed in rural areas. Overall, our study highlights the predominance of visual deformities in rural areas, possibly attributable to factors such as limited access to eye care, socioeconomic disparities, environmental conditions, and educational resources.

The overall incidence has been reported to vary between 21% and 25% of patients attending eye impairment in India.[8] It has been studied that all the visual impairment are dependent on different lifestyles or living conditions like reading in improper manner, watching TV continuously, or using computer, visual display units and most important is nutrition of child.[14,15]

The present study also observed the visual parameters based on age, height, weight & BMI and were in accordance with the study conducted by Vasantha N et al[16] has reported that visual impairment in overweight/obese group was significantly higher than the underweight and normal groups. In the identical study conducted by Bakare PN et al[17] reported a high prevalence of uncorrected refractive error in urban areas. Early detection of uncorrected refractive error and ocular morbidity will improve overall performance in school-going children. Another similar study conducted by Padhye AS et al[18] found that urban children were more likely to have uncorrected refractive error, particularly myopia. It is important to determine the root causes of the higher prevalence and to remove any obstacles to refractive error correction services. It is advised that schoolchildren have eye exams. For schoolchildren in urban and rural areas, the method may vary.

To prevent future dissatisfaction and assist the child in selecting a suitable career, colour vision abnormalities in school-aged children should be identified as soon as possible and appropriate counselling should be provided.[12]The study's findings suggested that children's eye screening exams be tailored to their learning capacity and selected based on their communication skills.

5. Conclusion

In this study, we investigated stereo acuity, accommodation amplitude, and refractive status in urban and rural children to understand differences in visual development. Notably, we found significant variations in stereo acuity, possibly influenced by environmental factors and lifestyle choices. Accommodation amplitude showed minimal differences between urban and rural populations, this emphasizes the role of near work activities and outdoor experiences in maintaining a healthy accommodation capacity. Refractive status also displayed disparities, indicative of the influence of lifestyle, healthcare access, and environmental factors on visual characteristics in young individuals. Collaboration among school administrations, teachers, and parents is key to creating an environment that encourages eye screenings and provides assistance to students with visual challenges. By prioritizing visual health, we empower children to reach their full potential, ensuring a brighter future. The high prevalence of visual impairments and color vision deficiencies among school-age children is concerning, affecting both academic success and self-esteem."

6. Limitation in Study

We acknowledge certain limitations of this study, including sample size variations and potential selection bias. Future studies with bigger, more varied sample sizes and longitudinal designs may offer deeper understandings of the elements affecting young children's visual development in both urban and rural areas.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Powell C, Evans JR, Morjaria P. Vision screening for correctable visual acuity deficits in school-age children and adolescents. *Cochrane Database Syst Rev*. 2018;2(2):CD005023.
2. Metsing TI, Ferreira JT. Visual deficiencies in children from mainstream and learning-disabled schools in Johannesburg, South Africa. *S Afr Optom*. 2008;67:176–84.
3. Moodley VR. Amplitude, facility and accuracy of accommodation in a primary school population. *S Afr Optom*. 2008;67:147–54.
4. Sethi S, Kashyap R, Student U, Kalan K. Impact ofrefractive errors on stereopsis in school going. *Indian J Clin Exp Ophthalmol*. 2015;1(2):91–4.
5. Saladin JJ. Effects of heterophoria on stereopsis. *Optom Vis Sci*. 1995;72(7):487–92.
6. Garzia R. The relationship between visual efficiency problems and learning. In: Optometric management of learning-related vision problems. St. Louis: Mosby Elsevier; 2006. p. 209–80.
7. Scheiman M, Wick B. Clinical Management of Binocular Vision: Heterophoric, Accommodative, and Eye Movement Disorders. *Optom Vis Sci*. 2009;86(11):1313–20.
8. Peter K, Kaiser MD. Prospective evaluation of visual acuity assessment: a comparison of snellen versus ETDRS charts in clinical practice (An AOS Thesis). *Trans Am Ophthalmol Soc*. 2009;107:311–24.
9. Cotter SA, Lee DY, French AL. Evaluation of a new color vision test: "color vision testing made easy". *Optom Vis Sci*. 1999;76(9):631–6.
10. Erickson GB, Block SS. Testability of a color vision screening test in a population with mental retardation. *J Am Optom Assoc*. 1999;70(12):758–63.
11. Trachimowicz R, Dat BS, Steele G. The effects of uncorrected refractive errors on three tests of stereopsis. *Optom Vis Sci*. 2000;77:271–80.
12. Ip JM, Robaei D, Kifley A, Wang JJ, Rose KA, Mitchel P. Prevalence of hyperopia and associations with eye findings in 6- and 12-year-olds. *Ophthalmology*. 2008;115(4):678–85.
13. Kulp MT, Ying G, Huang J, Maguire M, Quinn G, Ciner EB, et al. Associations between hyperopia and other vision and refractive error characteristics. *Optom Vis Sci*. 2014;91(4):383–9.
14. Wedner SH. Prevalence of eye diseases in primary school children in a rural area of Tanzania. *Br J Ophthalmol*. 2000;84(11):1291–7.
15. He M, Xu J, Yin Q, Ellwein LB. Need and challenges of refractive correction in urban Chinese school children. *Optom Vis Sci*. 2005;82(4):229–34.
16. Vasantha N, Haleema A, Raheena KP, Parvathy PS, Haneef M. A study on the prevalence of ocular disorders among school going children in the age group of 5 to 12 years. *Indian J Clin Exp Ophthalmol*. 2021;7(1):73–7.
17. Bakare PN, Gogate P, Magdum R, Phadke S, Maheshgauri R. Estimation of the Prevalence of Uncorrected Refractive Error and Other Ocular Morbid Conditions in School Children of Industrial Area in a Non-metro City in India. *Cureus*. 2022;14(8):e27972.
18. Padhye AS, Khandekar R, Dharmadhikari S, Dole K, Gogate P, Deshpande M. Prevalence of uncorrected refractive error and other eye problems among urban and rural school children. *Middle East Afr J Ophthalmol*. 2009;16(2):69–74.

Author's biography

Susmita Banerjee, Assistant Professor https://orcid.org/0000-0002-5410-3369

Renu Magdum, Professor https://orcid.org/0000-0003-2479-803X

Veshal Madan, Director https://orcid.org/0000-0003-4448-5380

Madhura Gandhi, Statistician

Cite this article: Banerjee S, Magdum R, Madan V, Gandhi M. Exploring visual functionality in school-going children (6-12 years) from urban and rural district of Pune. *Indian J Clin Exp Ophthalmol* 2024;10(4):777-782.