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COMPARATIVE STUDY OF VISUAL ACUITY, COLOUR VISION & REFRACTIVE STATUS IN SCHOOL GOING CHILDREN OF 6-12 YEARS OF AGE IN URBAN AND RURAL AREAS OF PUNE DISTRICT AUTHOR INFORMATION AND CONTRIBUTION:

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ABSTRACT:

Background: Visual acuity and color vision are crucial aspects of vision, impacting individuals' ability to perceive details and discern colors accurately. Understanding the prevalence of impairments in these areas among urban and rural school-going children is vital for addressing potential academic and social development implications.
Aim: This study aims to assess the prevalence of visual acuity, color vision, and refractive index impairments among urban and rural school children in Pune District, Maharashtra.
Materials and Methods: A cross-sectional study was conducted in three urban and four rural areas of Pune District, selecting a total of 900 school children, with 450 from each area. Visual acuity was assessed using Snellen's chart, and color vision was evaluated using the Ishihara color vision test. Data analysis utilized logMAR values.
Results: Demographic analysis revealed a majority of 16.6% of school children aged 9 years, with a male-to-female ratio of 1:1.16. Myopia was observed in 215 participants, with a statistically significant difference between urban (94.8%) and rural (70.7%) areas. Hypermetropia was present in 50 participants, with significantly higher prevalence in rural areas (29.3%) compared to urban areas (5.2%).
Conclusion: Early detection of visual impairments is crucial for timely intervention to prevent deterioration of visual function. Schools and parents should prioritize regular eye check-ups to ensure optimal vision health in children. The high prevalence of visual impairments and color vision deficiencies among school-age children underscores the importance of addressing these issues to mitigate potential impacts on academic success and self-esteem.

Keywords: Visual acuity, color vision, refractive index, school children, urban, rural.

1. INTRODUCTION

The visual system plays a crucial role in the development and education of school-going children. Visual perception is fundamental to the learning process. Good vision is essential for absorbing and processing information effectively and are better equipped to excel in school. Healthy vision contributes to a child's overall physical and emotional well-being. Parents, teachers, and healthcare professionals must be careful about ensuring that children who attend school have regular eye exams, must have access to corrective eyewear when necessary, and must teach them the value of excellent eye care and visual habits.

Visual acuity is the ability of the eyes to identify minute details and discriminate objects at a certain distance, which is the sharpness or clarity of vision. It is an important feature of visual function that is commonly measured by optometrists and ophthalmologists using a standardised eye chart, such as the Snellen chart.1 Visual acuity and color vision are essential components of visual function that significantly influence a child's learning, academic performance, and overall well-being.2 The result of the visual acuity test is given as a fraction, where the denominator denotes the distance at which a person with normal vision can see the same characters or symbols well. Typically, this distance is 20 feet or 6 metres.3

The capacity of the human eye and the visual system to see and identify various colours is referred to as colour vision, or chromatic vision. Cones, specialised cells in the human eye, are in responsible of how colours are perceived.4 These cones can distinguish the three fundamental colours of red, green, and blue and are sensitive to various light wavelengths. These cones interact with light as it enters the eye, and the brain uses the information from these interactions to create the impression of colour.5 The brain can interpret a wide range of colours by mixing different amounts of red, green, and blue cone stimulation, which enables us to perceive and differentiate the vivid and varied spectrum of hues in the environment around us.6

As part of the school health programme, screenings for visual acuity (Snellen notation) and colour vision (Ishihara test) were done on of 6-12 years of age in urban and rural areas of Pune district.7 However, results from vision screening tests among children with learning difficulties remained unclear since developmental delays, particularly in communication skills, have an impact on how well vision exams can be tested.8

A child's ability to learn and navigate their environment is fundamentally influenced by their vision. The ability to see clearly, or visual acuity, and colour perception are two essential factors that affect how well a child learns. Deficits in visual acuity and colour vision can have a big impact on a child's ability to learn, interact with others, and live in general quality.9 This study aims to compare and analyse the visual acuity and colour vision in school-going children to assess the prevalence of visual impairments and colour vision deficiencies, as well as to understand the potential implications for their academic and social development.

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 interventions and policies tailored to the specific needs of these populations."

The visual health of school-going children is a matter of significant concern, as untreated eye disorders can lead to academic difficulties and a reduced quality of life. By comparing visual health in these two settings, we can identify disparities and target interventions where they are needed most. Identifying vision problems in children at an early age is crucial for successful intervention. Visual acuity and color vision are vital for effective learning, especially in school-going children. Good vision is essential for daily activities and overall well-being.

Visual acuity, color vision, and refractive index impairments in children can adversely affect academic and social development. Impaired vision can hinder reading, writing, and participation in classroom activities, potentially leading to lower academic performance. Socially, it may result in stigmatization, reduced self-esteem, and limitations in participating in sports and play. Uncorrected vision issues can lead to behavioral problems, psychological distress, and missed educational opportunities. Early detection and intervention are crucial to mitigate these effects and provide children with the best opportunities for growth and development, underscoring the need for regular eye exams and appropriate vision correction.

2. MATERIALS AND METHODS

This is a cross sectional study conducted at the school of western Maharashtra, Pune District. Pune District is chosen for the study because it represents a diverse population, with both urban and rural areas. It is one of the more urbanized districts in Maharashtra, India, and is known for its demographic and socioeconomic diversity. Therefore, it provided valuable insights into the differences in eye health and vision-related issues between urban and rural settings.

In this study out of 14 talukas of Pune district, 3 urban and 4 rural areas are selected as per sampling convenience. The more rural areas might address potential disparities in healthcare access and eye health outcomes that are often more pronounced in rural settings. This can help in better understanding and addressing the unique challenges faced by children in these areas.

Ethical clearance was taken from DR D Y Patil Vidyapeeth Ethical Committee; Ref no: DYPV/EC/289/2019 Dated 6th June 2019. The consent from of each of the children was filled by parents to participate in the study, explaining them the study.

Total of 900 children's out of which 450 in each area (urban and rural) (for catering to the cluster sampling design the design effect of 2 was considered. The children within 6 to 12 years of age were included in this study. Childrens with any active ocular pathology, co morbidity and any additional disability other than visual impairment were excluded from the study. The permission from the principal of the school was taken to perform the study. The students enrolled for the study were assessed for Visual Acuity, Colour Vision.10

Snellen's chart is a conventional tool for evaluating visual acuity. It gained popularity in clinical settings where it was used for vision testing and eye exams. The chart is composed of numerous rows of symbols or characters in a range of sizes, with the largest letters at the top and smaller ones as you move down the page. The chart is standardised to be set 20 feet (6 metres) away from the test subject, though local variances may apply. The standard for normal vision, commonly represented as 20/20, is used to compare the subject's visual acuity. The patient's visual acuity is measured as 6/6, which is normal, when they can read up to a 6 m line.3

"The Snellen chart is widely recognized and has become a standardized tool for evaluating visual acuity. It offers a straightforward and quantifiable approach to measuring how well individuals can perceive objects at different distances. The Snellen notation system provides a meaningful representation of visual acuity, where 20/20 denotes normal or optimal vision, and other notations indicate varying degrees of vision impairment. This clinical relevance makes it particularly well-suited for the identification of visual acuity issues in school-aged children. Furthermore, utilizing the Snellen chart ensures comparability with a broad spectrum of previous and forthcoming studies, simplifying the assessment of visual acuity trends over time."

Statistical Analysis

The study was meticulously documented in an Excel spreadsheet, and a comprehensive statistical analysis was conducted. Descriptive measures such as mean, percentage, standard

deviation, and the chi-square test were applied to examine and interpret the data. Results indicated statistical significance for p-values less than 0.05.

Limitations of Snellen Chart:

Snellen charts may not be sensitive enough to detect subtle changes in visual acuity, especially in children. This limitation may be relevant when assessing mild vision impairments. VA measurements using Snellen charts are based on letter or symbol recognition. Some children may have difficulty recognizing specific letters, potentially leading to measurement errors.

This study used the Ishihara colour vision mention distance test, which is a popular screening technique and has been shown to be highly sensitive and specific for identifying red-green colour vision deficiencies. To take the test, is measured approximately 75cm from your monitor with each circle set at eye level.

Visual Acuity (VA) Measurement Endpoint:

"In this study, the term 'VA measurement endpoint' pertains to the specific visual acuity value obtained from the Snellen chart. For instance, an endpoint like '20/20' signifies normal vision. If a child achieves a value such as '20/30,' it implies that the child can see at 20 feet what a person with normal vision can see at 30 feet. These endpoints are used to gauge the child's visual acuity, enabling comparisons between urban and rural populations."

This study assessed the prevalence of visual Acuity, colour vision & refractive index impairment in urban and rural school-going children.

"The Ishihara test serves as a means to evaluate color vision deficiencies and color blindness. It typically consists of a series of plates, each displaying numbers or patterns concealed within a matrix of various colors. During the test, children are tasked with identifying the numbers or patterns on each plate. The protocol for the Ishihara test involves presenting the plates to the child in a predetermined sequence, commencing with the simplest and gradually progressing to more intricate ones. An appointed test administrator records the child's responses, and these results are then utilized to ascertain the child's color vision status."

The choice between Snellen notation and LogMAR notation for VA measurement depends on the specific research objectives and the level of precision required. Snellen notation is commonly used and easily interpretable, making it suitable for general assessments.

All the data was entered in micro soft excel. Data entry and analysis was used Statistical Package for the Social Sciences (SPSS) version 25.0. The evaluation of the visual acuity, color vision of school going children in rural and urban areas - Descriptive statistics. The comparison of all the visual functions of children between rural and urban areas- Independent t test. P-value less than 0.05 is considered as statistically significant.

3. RESULTS & OBSERVATIONS

Demographic study

In the demographic analysis (Table 1) encompassed a cohort of 450 paediatric participants from both urban and rural locales, yielding balanced representation between the two groups.

In the realm of age stratification, the mean age ± standard deviation was calculated as 8.38 ± 1.7 years for the urban cohort, while the rural cohort exhibited a mean age of 8.88 ± 1.50 years.

In the examination of gender distribution, the urban populace exhibited a composition of 178 individuals (39.6%) identifying as female and 272 individuals (60.4%) identifying as male. In the rural stratum, the female contingent numbered 205 individuals (45.6%), and the male cohort numbered 245 individuals (54.44%).

In the anthropometric metrics, the mean height ± standard deviation for urban participants measured 151.19 ± 6.49 centimeters, while their rural counterparts measured 140.10 ± 12.19 centimeters on average. The mean/SD of weight in Urban area was observed as 41.03 ± 9.48

and in rural area it is 33.30 ± 18.89. The mean/SD of BMI in Urban area was observed as 17.93 ± 3.66 and in rural area it is 16.23 ± 3.39. (Refer Table 1)

Study of Visual Impairment

(Table 2) 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.

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 groups or is not influenced by the urban or rural environment. (Refer Table 2)

Study of Taluka wise distribution

(Figure 1) It is observed that majority 161 (17.9%) school going children's were from Maval taluka, followed by Mulshi & Velhe taluka with 151 (16.8%) children's, 133 (14.8%) children's were from Beed and Khed taluka, 86 (9.6%) were from Haveli taluka & 84 (9.4%) children's from Pune city which is shown in figure 1.

Study of type of Refractive error based on geographical area

(Table 3) The study represents the type of Refractive error based on geographical area. In this study it was observed that Myopia observed in 215 participants that is 109 (94.8%) in Urban area and 106 (70.7%) in rural area were statistically significant.

Total 50 participants had hypermetropia with 6 (5.2%) from urban area and 44 (29.3%) from rural area and were statistically significant. (Refer Table 3)

4. DISCUSSION

The relevance of addressing visual health issues in the paediatric population is shown by the comparative study of visual acuity and colour vision in school-age children in the present study. Early detection and treatment of visual impairments can have a major impact on a child's learning capacity, academic success, and general wellbeing. The goal of vision testing in children is to identify vision issues, enhance prognosis, and lessen impairment. The lack of awareness in society makes it challenging to measure children's visual acuity. In this present study, out of 900 total population, 450 from children from urban schools and 450 from rural schools of Pune district were scrutinised for visual impairment. The total of 950 children studied were from Beed, Haveli, Khed, Maval, Mulshi. Pune City & Velhe area. The descriptive study of visual parameters based on age, height, weight & BMI was observed. (Refer Table 1) The visual functions of children between rural and urban areas showed no statistical significance.

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.9,10

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 al11 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 12 reported a high prevalence of uncorrected refractive error. 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 13 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. 14

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 conclusion, early detection is crucial for addressing visual issues and preserving visual function in children. Schools and parents should advocate regular eye check-ups to support children's vision health. 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."

'Declarations'

a. Competing Interests: No

b. Ethics approval and consent to participate-Ethical approval taken and consent letter from the principals of the schools.

c. Consent for publication: Yes

d. Availability of data and materials: Not Applicable

e. Funding: No

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Tables & Figures

Table 1 – Demographic study

Characteristics	**Urban Area (450)**	**Rural Area (450)**
Age	8.38 ± 1.7	8.88 ± 1.50
Female; N (%)	178 (39.6%)	205 (45.6%)
Male; N (%)	272 (60.4%)	245(54.44%)
Height	151.19 ± 6.49	$140.^{10}$ ± 12.19
Weight	41.03 ± 9.48	33.30 ± 18.89
B.M.I.	17.93 ± 3.66	16.23 ± 3.39

Values displayed are mean & SD

Table 2 – 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 3 - 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 represented by

Figure 1 - Study of Taluka wise distribution