VISUAL IMPAIRMENT AND REFRACTIVE ERROR PREVALENCE AMONG UTTAR PRADESH INDIA'S RURAL SCHOOL-AGE CHILDREN

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ABSTRACT

BACKGROUND: The purpose of this study is to evaluate the extent to which school-age children in rural communities experience refractive error as a cause of visual impairment, as well as its prevalence. One of the main causes of childhood blindness and visual impairment is refractive error, yet there are few community-based studies on the subject, particularly in rural India.

METHODS*:* From March 1 to April 30, 2022, a community-based cross-sectional descriptive study was carried out in rural communities located in the Kanpur district of U.P, which is situated near U.P capital, A basic random selection of representative villages within the district was done in conjunction with a multistage cluster sampling technique. The data analysis employed t-tests and Chi-Square. OUTCOMES: A total of 570 school-age children, 54% males and 46% girls, between the ages of 7 and 15 were assessed. 3.5% of people had refractive error, with myopia (2.6%) and hyperopia (0.9%). Of all the causes of visual impairment in the study group, 54% were attributed to refractive error, making it the primary cause. Throughout the study period, no child was discovered to be wearing corrective glasses.

CONCLUSIONS: The district's children's most common cause of vision impairment was refractive error, yet no steps were taken to lessen the burden on the community. Therefore, comprehensive community-level refractive error screening ought to be carried out and incorporated into routine school eye screening initiatives. In remote communities, cost-effective methods for supplying corrective glasses must be developed.

KEYWORDS: Children, visual acuity, refractive error, and visual impairment

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INTRODUCTION

One of the most frequent causes of vision impairment is refractive error. According to recent research, many individuals worldwide may be blinded by significant refractive error as a result of improper usage of refractive corrections (1).

The worldwide extent of refractive error cannot be accurately determined due to significant differences in classifications based on age, blindness criteria, and testing techniques. Refractive errors are thought to be the cause of 5–25% of blindness in various countries, affecting up to 4% of the population whose vision is less than 6/18 (2).

Because best corrected visual acuity (BCVA) has been the basis for many definitions of blindness, refractive error as a cause of blindness has not gotten much attention. If blindness were determined by displaying distance visual acuity, however, refractive error would rise to the second most common cause of curable blindness in many regions of the world (3). The WHO's 2008 report on global meta-analysis serves as more evidence for this claim.

This paper estimates that uncorrected refractive errors cause visual impairment in 153 million people worldwide, 8 million of whom are blind. Estimates based on best corrected vision have previously ignored this cause of visual impairment. This demonstrated that the primary cause of poor vision and the second leading cause of blindness is uncorrected refractive error (4) U.P has a 1.6% blindness rate and a 3.7% low vision (vision less than 6/18) rate, according to the results of the 2005–2006 "National Survey on Blindness, Low Vision and Trachoma in India." However, despite the fact that children were included in the general population, the burden of refractive error in them was not highlighted in this survey (5). Children should receive special attention since visual impairment limits their educational chances, overall performance, personality development, future quality of life, and professional prospects, all of which have an impact on their success over the long term (6).

There are several methods for evaluating a child's refractive error. The two most popular methods are the vision screening approaches used in schools and the community. Not all children in underdeveloped nations like U.P attend school on time, and other children may not even go to school at all because of refractive error-related vision impairment. Therefore, community vision screening may be the best approach to include these children if screening based on schools is unable to reach them.

There isn’t many research on this topic conducted in Ethiopian schools. Based on these data, we conducted a study whose goal was to ascertain the prevalence of refractive error and how it affects childhood visual impairments in school-age children living in rural communities. This study also identified additional reasons of vision impairment.

MATERIALS AND METHODS

From March 1 to April 30, 2022, a community-based, cross-sectional, descriptive study was conducted among children residing in rural communities in Kanpur District, in India, who were between the ages of 7 and 15. It was chosen for this study after taking into account factors including cost, labour, and time. The entire population of district was 4581000 Approx. Children under the age of five make up about 11% of the population. About 08% of the total, are between the ages of 7 and 15 . The computed sample size was 544 children, taking into consideration the margin of error of 2.5%, the design effect of 1.5, and the percentage of refractive error in the previous comparable studies in the area (6.3%).

The research sample was chosen by a multistage cluster sampling method. Peasant associations (PAs), considered a first stage cluster, are the geographical divisions into which the district was placed. The villages within the district, each with an average of fifty households. During the study period, Indian households were predicted to have an average size of five, the data collectors registered and included in the study all the children aged 7 to 15 who lived in these villages. As a result, 570 kids were involved, which is marginally more than the sample size that was estimated. Once the parents gave their informed agreement, each of them was inspected in their individual communities. Prior to an ophthalmic evaluation, basic data such as name, age, gender, and years of education were noted for each eligible child. Measurement of distant visual acuity, subjective refraction, assessment of ocular alignment and motility, and inspection of the anterior segment and fundus are among the ophthalmic examinations.

Snellen's E-chart at a height of six meters was used to test visual acuity in direct sunlight. Children whose uncorrected vision was 6/12

or worse underwent pinhole visual acuity testing. Subjective refraction was performed using a conventional refraction trial set on children who shown improvement with pinhole.

Further testing included ocular alignment at 0.5 and 4 meters (for near and far vision, respectively), ocular motility, anterior segment evaluation with a torch light and magnifying loupe, and posterior segment evaluation with a direct ophthalmoscope following pupillary dilation with a 1% tropicamide eye drop for the children whose uncorrected vision was 6/12 or worse and who did not see any improvement with pinhole. In the end, children who had retinal findings suggestive of extreme myopia but no improvement with pinhole underwent subjective refraction. Following the completion of the ocular examination, the primary cause of uncorrected vision of 6/12 or worse was noted. Refractive error, corneal opacity from any cause, cataracts, retinal diseases, amblyopia, and other causes were the categories used to group the causes.

In this study, visual impairment was defined as vision worse than 6/18 in the better eye, while subnormal vision was defined as vision of 6/9 or worse in the better eye. Myopia was defined as refractive error requiring a correction of minus 0.50 dioptres or more, and hyperopia as needing a correction of + 1.00 dioptres or more. Children with low vision that does not improve with refraction and no underlying pathology leading to visual loss were diagnosed with amblyopia.

SPSS software version 16 was used to input and process all of the data. When appropriate, two-tailed t-tests or x2-tests were used for statistical testing of significance, and p-values of less than 0.05 were regarded as significant. The Research and Publication Committee of the Department of Optometry at the Medical Faculty of Rama University gave its approval before the study could be carried out. Additionally, approval was received from the relevant authorities and interested parties. After informing each child's parents about the process and goal of the study, informed consent was acquired.

RESULTS

A 96% response rate was achieved over the study period, with 592 children aged 7-15 years who were registered and 570 of them taking part in the research. Of them, boys made up 54%. Table 1 shows that a total of 375 children (65.8%) were between the ages of 7 and 10, while the remaining 195 (34.2%) were between the ages of 11 and 15.

Table 1: Age and sex distribution of the school- age children in rural Mar 1- April 30, 2022.

	Sex		**Total**
Age group	F	M	
7-9 yrs.	115	135	250(43.9%)
10-12 yrs.	106	137	243(42.6%)
13-14 yrs.	41	36	77(13.5%)
Total	262	308	570(100%)

Among the children, the majority (71.6%) were in grade 1-3. A total of 34 children (6%) did not startschooling (Table 2).

Table 2: Distribution of school grade among the rural children (Age 7-15 years); Mar 1–Apr 30, 2022.

SchoolGrade	**Sex**		**Total**
	F	M	
Didn’t start	16	18	34(6.0%)

1 – 6	243	283	526(92.3%)
7 – 9	3	7	10(1.7%)
Total	262(46%)	308(54%)	570(100%)

In all, 533 kids (93.5%) had two eyes with presenting vision of 6/9 or better. In one or both eyes, the remaining 37 children, or 6.5%, had presenting vision of 6/12 or worse. Twenty of them, or 3.5% of the total, had two eyes with vision of 6/12 or worse. Ten kids, or 1.75 percent of the total, had presenting vision worse than 6/18 (Table 3).

Table 3: Distribution of presenting and BCVA* in rural school-age children; Mar 1-Apr 30,2022

VA groups	**Frequency of Presenting Visual AcuityNumber (%)**	**Frequency ofBCVA*(%)**
≥6/9 in both eyes	533(93.5)	546(95.8)
≥6/9 in the better eye	17(3.0)	13(2.3)
6/12-6/18 in the better eye	10 (1.8)	3(0.5)
<6/18-3/60 in the better eye	10 [1.8]	8(1.4)
<3/60 in the better eye	0	0
Total	570(100)	570(100)

* *Best Corrected Visual Acuity*

When 546 youngsters (95.8%) had their best corrected visual acuity (BCVA) evaluated, they had eyesight of 6/9 or better. Merely 24 kids (4.2%) had a BCVA of 6/12 or lower in either or both eyes; 11 of them (1.8% of the total) had this condition in both eyes, while 13 of them (2.4%) had it in just one. Based on WHO criteria, there were three children with unilateral blindness but no bilaterally blind child.

The distribution of presenting visual acuity did not differ significantly between boys (M = 0.89, SD = 0.18) and girls (M= 0.86, SD = 0.16) (t = 0.58, p-value = 0.56 for the right eye, t- test). There was also no statistically significant difference in the mean presenting vision between children who didn't start schools (M = 0.90, SD = 0.18) and those who were at schools in the same age group (M = 0.89, SD = 0.19) (t= 0.17, p-value = 0.87, right eye, t-test).

The most frequent cause of low vision, both unilateral and bilateral, was refractive error. Twenty (54%) of the 37 kids who had low vision—either unilaterally or bilaterally—had refractive error. Thirteen of the twenty children with refractive error were bilaterally involved. With proportions of 10.8%, 8.1%, and 5.4%, respectively, retinal causes, corneal opacity, and strabismic amblyopia were the other main causes of either unilateral or bilateral subnormal visual acuity. Five children (13.5%) had no known cause for their impaired visual acuity, but amblyopia was the most plausible explanation due to the lack of any observable pathology, despite the fact that the condition did not meet the official criteria for amblyopia diagnosis.

Three infants in this investigation had unilateral blindness due to congenital cataract, enucleation following trauma, and phthisis bulbi of unknown cause, all affecting one eye (Table 4).

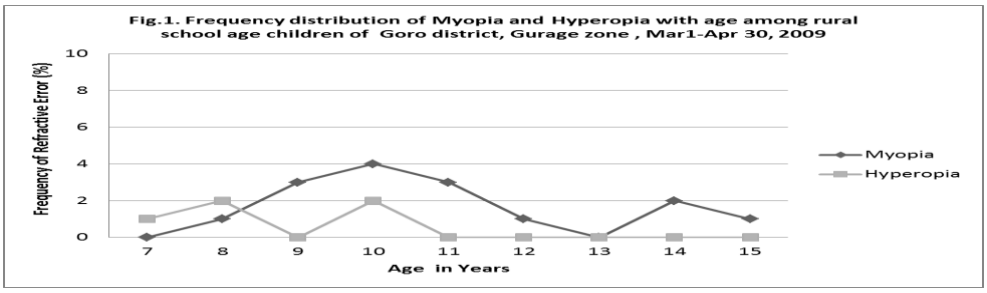
Table 4: causes of low eyesight school-age rural children, defined as visual acuity of 6/12 or worse. March 1–April 30, 2009

Causes	No. of eyes with VA of ≤6/12 (%) OD	OS	No. of children With VA of ≤6/12 in one or both eyes (%)	Prevalence of VA ≤6/12 in one or both eyes (%)
Refractive Error*	16(51.7)	17(65.7)	20(54.0)	3.51
Retinal abn.	4(12.9)	3(11.5)	4(10.8)	0.70
Corneal Opacity	3(9.7)	2(7.7)	3(8.1)	0.53
Strab. Amblyopia**	1(3.2)	1(3.8)	2(5.4)	0.35
Phthisic eye	1(3.2)	-	1(2.7)	0.18
Enucleated	1(3.2)	-	1(2.7)	0.18
Cataract	1(3.2)	-	1(2.7)	0.18
Undefined	4(12.9)	3(11.5)	5(13.5)	0.88
Total	31(100)	26(100)	37(100) -	6.50

* 2 children have bilateral amblyopia due to high myopia, ** strabismic amblyopia

* * Of the kids who had refractive errors, 5 (25%) were hyperopic and 15 (75%) were myopic.

* The children's mean refractive errors were -1.16 D for the right eye and 0.90 D for the left. There was no statistically significant difference between the two eyes' observations. The mean value in the right eye of the same children with refractive error was -0.69 (SD=3.83) in males and -1.889D (SD=3.31) in females. Although the difference was not statistically significant (p-value=0.48), women had a tendency to be more myopic. In all, 2.6% of the youngsters had myopia and 0.9% had hyperopia (Fig. 1). No child was using corrective lenses at the time of the study.



DISCUSSION

Globally, the distribution of refractive error differs, and until recently, there was no widely recognized standard method for evaluating and disclosing the issue. Currently, a standard methodology known as "Refractive Error Study in Children" (RESC) is used to address this problem. It is implemented in a few nations, including China, Nepal, Chile, India, Malaysia, and South Africa. These investigations have produced encouraging equivalent outcomes (4). However, due to a lack of funding and labour, particularly in developing nations like India, it is challenging to conduct such a thorough study in rural communities across the globe. While not as thorough, our investigation was comparable to those carried out by the RESC procedure.

In this study, 1.8% of participants had visual impairment, defined as exhibiting vision less than 6/18. This is similar, if marginally lower, than a prior study of a similar nature

conducted five years ago at a district school, which reported a visual impairment rate of 2.2% (9). Our study's low vision prevalence (3.5%) Iran's (3.8%) but much lower than those from studies conducted in Malaysia (17.1%), Chile (15.8%), China (12.8%), urban India (9.0%), and, to a lesser extent, rural Ethopia (5.0%) (10–15). It is higher than research conducted in other nations, such as South Africa (2.7%) and Nepal (2.9%), though (14–15). The prevalence of low vision in another study conducted in rural India was 2.7%, which is marginally less than what we found (15). In our study, refractive error was the primary cause of both unilateral and bilateral vision impairment.

Most research conducted in other nations is comparable to this one. According to research conducted in India, the percentage of refractive error resulting from total sources of visual impairment varies from 53% to 87% in Iran and 90% in Tanzanian children within the same age group (10, 15, 18,).

The percentage of youngsters in our research that had refractive error was 3.5% overall. Comparing this figure to a survey conducted in ethopia, which found 11.6% of school-age children in that country (19) is extremely low. Additionally, it is less than Iran's (6.13% in the 7–15 age range) (8). However, it is greater than comparable research conducted in Tanzania (1%), India (1.9%), and South Africa (1.82%) (15,17,18).This wide range may be caused by racial/ethnic differences, lifestyle differences, or living conditions in different nations, as indicated by a number of previous studies that demonstrate a substantial relationship between these factors and refractive error (20–22).

Myopia accounted for 75% of the cases with refractive error in our study, making it the most common form. In all, 2.6% of people had myopia and 0.99% had hyperopia. Although the prevalence of myopia is higher than in Tanzania (0.7%) and Nepal (1.2%), it is lower than in China (16.2%), urban India (New Delhi = 7.4%), rural India (4.1%), and Iran (3.4%) (10, 13–15). Our outcome is comparable to those of Uganda (2.7%) and South Africa (2.9%) (17, 19).

research to research differs in which types of refractive error are most common. Children's objective refraction typically reveals a significant preponderance of hyperopia. However, because of proper accommodations, the majority of the kids have normal eyesight. On the other hand, the majority of subjective refractions in children with low vision indicate that myopia predominates in various research. This observation aligns with the findings of our investigation.

In summary, refractive error was shown to be the most common cause of visual impairment in district children; nevertheless, no steps were done to lessen this burden on the community. There was not a single child in sight with corrective glasses. It is advised that more extensive community-level screenings for refractive error and visual impairment be conducted on children, and that these screenings be incorporated with routine school eye screening initiatives. Additionally, efficient plans should be developed to raise awareness and offer the local youngsters reasonably priced corrective eyewear.

REFERENCES

1. Leon B. Ellwen. Case finding in refractive error. *Community Eye Health. 2002*; 15:43.
2. Developing an action plan: specific disease control strategies. *VISION 2020 CD-ROM, chapter 3.*
3. *World Health Organization*. Elimination of avoidable visual disability due to refractive error. 2001; 79:3.
4. *Bull. World Health Organ*. vol.86 no.1 Geneva Jan. 2008.
5. Yemane B, Alemayehu W, Abebe B et.al. Prevalence and causes of blindness and Low Vision in Ethiopia. *Ethiop. J. Health Dev. 2007;*21(3):204-210.
6. Brien A Holden. The role of optometry in VISION 2020. 2002; 15(43):33-36
7. CSA (*central Statistics Agency of Ethiopia*), 2005. National Statistics, Central Statistical Agency, Addis

Ababa: Ethiopia.

8. *Macro International Inc. 2007*. Trends in Demographic and Reproductive HealthIndicators in Ethiopia. Calverton, Maryland, USA: Macro International Inc.
   Mohammed S, Abebe B. Common eye diseases in children of rural community in Goro district, central Ethiopia. *Ethiopian Journal of Health Dev. 2005*;19(2): 148-152.
9. Akbar F, Hassan H, Mehdi K et.al. The prevalence of refractive errors among schoolchildren in Dezful, Iran. *Br. J.Ophthalmol.* 2007; 91:287-292.
10. Goh P, Abqariyah Y, Pokharel GP, Leon B. Refractive Error and Visual Impairment inSchool-Age Children in Gombak District, Malaysia. *Ophthalmology.* 2005;112:678–85.
11. Maul E, Barroso S, Munoz S, Sperduto R, Ellwein L. Refractive error study in children: La Florida, Chile. *Am J Ophthalmol.* 2000;129: 445–454.
12. Zhao J, Pan X, Sui R et.al Refractive error study in children: results from Shunyi District, China. *Am J Ophthalmol*. 2000; 129:427–435.
13. Murthy GVS, Gupta SK, Ellwein L. Refractive error in children in an urban population in New Delhi. *Invest Ophthalmol Vis Sci. 2002*; 43:623–631.
14. Dandona R, Dandona L, Srinivas M et al. Refractive error study in children in a rural population in India. *Invest Ophthalmol Vis Sci. 2002*; 43:615–622.
15. Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. *Am J Ophthalmol 2000*;129:436–44.
16. Naidoo KS, Raghunandan A, Mashige KP et al. Refractive Error and Visual Impairment inAfrican Children, South Africa. *Invest Ophthalmol Vis Sci 2003*;44:3764–70.
17. Susanne H, David A, Rebecca B. Prevalence of eye diseases in primary school children in a rural area of Tanzania. *Br. J. Ophthalmol. 2000*;84;1291-1297.
18. Medi K. and Robert M. A survey of the prevalence of refractive errors among children in lower primary schools in Kampala district. *African Health Sciences 2002*;2(2):69-72.
19. Kleinstein RN, Jones LA, Hullett S, Kwon S et al. Refractive error and ethnicity in children. *Arch Ophthalmol 2003*; 121: 1141–1147.
20. Rose KA, Morgan IG, Ip J, Kifley A, Huynh S, Smith W, Mitchell P. Outdoor activity reduces the prevalence of myopia in children. *Ophthalmology. 2008;* 115: 1279–1285.
21. KA, Morgan IG, Smith W, Burlutsky G, Mitchell P, Saw SM. Myopia, lifestyle, and schooling in students of Chinese ethnicity in Singapore and Sydney. *Rose Arch Ophthalmol. 2008*; 126(4):527-30