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Original Research Article

Prevalence of refractive error among school children in North-West Rajasthan

Nabab Ali Khan, Mahendra Kumar Jangir*, Anju Kochar and Poonam Bhargava

Department of Ophthalmology, Sardar Patel Medical College, Bikaner, India

***Correspondence Info:**
Dr. Mahendra Kumar Jangir
Resident,
Department of Ophthalmology,
Sardar Patel Medical College, Bikaner, India
E-mail:dr.mahendra.sms@gmail.com

Abstract

Purpose: To study the prevalence and relative frequency of refractive error among school children in North-West Rajasthan so that an effective approach can be planned to tackle the burden of readily correctable refraction problems.
Methods: A cross-sectional descriptive study was carried out to study the magnitude of refractive errors among school children in North-west Rajasthan.
Results: A total of 1078 children were examined. The subjects consist of 702 females (65.1%) and 376 males (34.9%). The children were aged 5–19 years (mean = 9.8 ± 3.2 years, 95% confidence interval [CI] 9.6–10.0). 265 children representing 24.6% (95% CI: 21.9–27.8%) of the children examined had refractive errors. This comprises of astigmatism (n=134,12.4%), followed by myopia (n=68,6.3%) and hyperopia (n= 63, 5.8%), of the 1078 children examined.
Conclusion: Refractive error was found in 24.6% of the subjects, astigmatism being the most common followed by myopia and hyperopia. Cost-effective strategies for vision screening of school children should be incorporated into the school health programmes to prevent devastating impact of visual impairment on a child's education and development.
Keywords: Refractiveerror, School children, Visual acuity.

1. Introduction

Visual impairment resulting from uncorrected refractive errors remains a significant public health problem worldwide. The significance of refractive error as a cause of visual impairment only recently assumed ascendancy following the re-conceptualization of visual impairment (blindness and low vision) using presenting visual acuity rather than best corrected visual acuity [1].

Using presenting visual acuity (VA) allows for the estimation of the magnitude of visual impairment due to refractive errors. Blindness is defined in terms of visual acuity (VA) as, 3/60 in the better seeing eye and low vision as VA between 6/18 to 3/60 in the better seeing eye.[2]

An estimated 2.3 billion people worldwide have refractive errors and of these, only 1.8 billion have access to an eye examination and affordable refractive correction. The majority of the 500 million who do not have access to refractive error services live in developing countries and are mainly children.[3]

Undetected and uncorrected refractive errors are a particularly significant problem in school children. Poor vision and an inability to read material on the chalkboard due to refractive error can profoundly affect a child's participation and learning in the classroom.[4]

These factors may combine to make the child drop out of school and be a victim of the attendant social problems associated with school drop-outs. Not infrequently, parents and siblings may undermine and discourage these children. One report has documented the severe impact of poor vision on primary school children in Brazil in which they found that children with reduced vision had a 10% higher probability of dropping out of school, an 18%higher probability of repeating a grade and scored about 0.2 to 0.3 standard deviations lower on achievement test. This study did not, however, indicate whether the poor vision was due to refractive error or not. It does provide a peek into the impact of poor vision on academic achievement.[5]

The purpose of this study was to gather information on the refractive status of students so that an effective approach can be planned to tackle the burden of readily correctable refraction problems in school children. Children were also prescribed glasses and medicines when found necessary. When encountered with diseases that could not be managed at schools, were brought to tertiary eye care centre for appropriate management.

2. Material and Methods

2.1 Study design and Sampling

A cross-sectional descriptive study was carried out to study the magnitude of refractive errors among

schoolchildren in North-west Rajasthan. All schools of the district, in which our tertiary eye care centre is located, are divided into five circuits. Each circuit constitutes a cluster of schools from which one school was randomly selected.

The study involved the examination of all children in the schools that were selected at random from each circuit. Using the expression $n = Z^2 (1-p)(p)/b^2$ (where n = minimum sample size, p = anticipated prevalence[assumed to be 50%], b = desired error bound taken as 5%and Z = the standard score at 95%), a minimum sample of402 was calculated. To account for a 10% attrition rate, the sample size became 442. To accommodate for inefficiencies associated with cluster sample design, an increase of 100% is allowed due to the small number of clusters. This gave a final sample size of 884. In the present study, 1152 children were enumerated. Of these, 1078 children participated and were examined giving a participation rate of 93.6%.

2.2 Clinical team and field operation

Institutional approval to carry out the study was obtained from the concerned authorities of our tertiary hospital. Additionally, permission was sought and obtained from the local education authority. The heads of selected schools were briefed on the purpose of the study and they signed an informed consent form on behalf of the school children. In addition, the assent of children was sought before they were examined.

The examination team consisted of two ophthalmologists and three optometrists. All members of team were briefed on the purpose of the study and were trained on carrying out clinical procedures in the field. The two ophthalmologists performed all the refraction and cross-checked the examination form to ensure that they were accurately filled out. All the members of examination team had previously participated in out of clinic eye care programs.

2.3 Clinical examination

The original Refractive Error Study in School Children (RESC) protocol was relied upon in designing the examination form. VA was measured at a distance of 6 m using the Snellen tumbling E and standard Snellen chart. Children who wore glasses also had their VA taken while wearing their glasses. The presence of ocular deviation (phoria and tropia) was determined using the cover uncover test. Ocular health examination including external and fundus examination using direct ophthalmoscope was performed for all children examined. We performed retinoscopy 30 minutes after the instillation of the cyclopentolate hydrochloride (1% solution). The final prescription after subjective refraction was performed next day and the best-corrected VA was recorded. Medication was prescribed for minor ocular conditions at the time of the examination while those who needed further medical or diagnostic work-up were referred to our hospital.

2.4 Data analysis

The data forms were checked for accuracy and completeness in the field before data entry. Refractive error was assigned as the cause of the visual impairment if in the absence of any obvious pathology, vision improved to 6/6 or better with refraction. Amblyopia was assigned the cause of visual impairment when, in the absence of any noticeable pathology or abnormality, there was no improvement in vision with refraction. Hyperopia was defined as a spherical power of +2.00 diopters sphere (DS) in both eyes or in one eye (if the other eye is emmetropic). Myopia was defined as a spherical power of -0.50 DS in both eyes or in one eye (if the other eye was emmetropic). A cylindrical power of +/−0.50 diopters cylinder (DC) in both eyes or in one eye (if the other eye was emmetropic) was considered as astigmatism. When there was a difference in refraction between the two eyes greater than 2.00 diopters (D), it was designated as anisometropia. The results of the right eye were used to determine the refractive errors present. This is because the mean refractive error measurement has been reported to be similar in both left and right eyes.[6]

3. Results

A total of 1152 children were enumerated for the study out of which 1078 children were examined. This gave a participation rate of 93.6%. This includes children who were present on the days of the examination and for whom informed consent for examination could be taken.

The results of 1078 children are presented below (Table 1 and Figure 1). The subjects consist of 702 females (65.1%) and 376 males (34.9%). The children were aged 5–19 years (mean = 9.8 ± 3.2 years, 95% confidence interval [CI]: 9.6–10.0). The majority were aged 11–13 years (31.8%). The mean age for the females was 10.4 ± 2.9 years (95% CI: 10.2–10.6), while that for the males was 10.0 ± 3.4 years (95% CI: 9.6–10.4).

Table 1: Gender distribution of enumerated and examined

	Enumerated (%)	Examined (%)
Males	407(35.3)	376(34.9)
Females	745(64.7)	702(65.1)
Total	1152(100)	1078(100)

Figure 1: Graph showing gender distribution of enumerated and examined

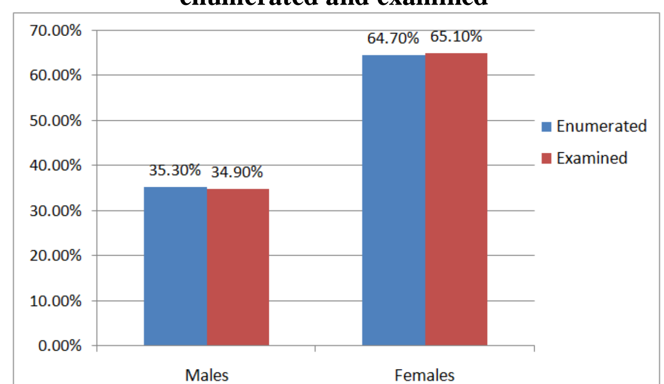


Table 2: Distribution of visual acuity

Visual acuity	Right eye (%)	Left eye (%)
>6/6	939(81.5)	928(80.5)
6/9	60(5.2)	64(5.5)
6/12	8(0.6)	12(1.0)
6/18	4(0.3)	6(0.5)
6/24	3(0.3)	2(0.2)
6/36	2(0.2)	3(0.2)
6/60	3(0.3)	4(0.3)
3/60	1(0.1)	1(0.1)
Undetermined	58(5.0)	58(5.0)

The distribution of the refractive pattern by age and gender is presented in Tables 3. This shows higher prevalence of hyperopia in lower age group being most common in 5-7years (n=26; 10.9%) and myopia most common in 11-13 year age group (n=36; 10.4%)

Table 3: Distribution of refractive pattern by age

Age (yrs)	Emmetropia n(%)	Hyperopia n(%)	Myopia n(%)	Astigmatism n(%)
5-7	181(75.7)	26(10.9)	4(1.7)	28(11.7)
8-10	202(71.1)	12(4.2)	18(6.3)	52(18.3)
11-13	265(76.6)	7(2.0)	36(10.4)	38(11.0)
14-16	105(69.1)	6(3.9)	12(7.9)	29(19.1)
17-19	50(87.7)	1(1.8)	2(3.5)	4(7.0)
Total	803(74.5)	52(4.8)	72(6.7)	151(14.0)

($\chi2 = 57.06$, df = 16, p = < 0.0001)

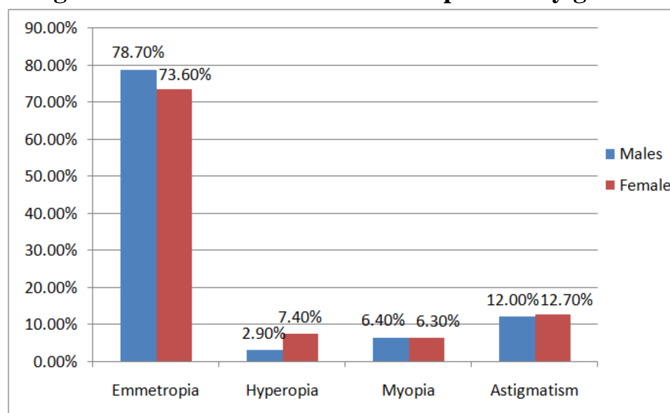
The distribution of the refractive pattern by gender is presented in Table 4 and figure 2 which shows that 265 children representing 24.6% (95% CI: 21.9–27.8%) of the children examined had refractive errors. This comprises of 63 (5.8%) hyperopia, 68 (6.3%) myopia and 134 (12.4%) astigmatism of the 1078 children examined. Thus of the 265 children with refractive errors, the commonest refractive error was astigmatism accounting for 50.6% followed by myopia and hyperopia with 25.7% and 23.8% respectively. The type of refractive error was dependent on the age of a child ($\chi2 = 57.06$, df = 16, p = < 0.0001).

Table 4: Distribution of refractive pattern by gender

Type of refractive error	Male (%)	Female (%)	Total (%)
Emmetropia	296(78.7)	517(73.6)	813(75.4)
Hyperopia	11(2.9)	52(7.4)	63(5.8)
Myopia	24(6.4)	44(6.3)	68(6.3)
Astigmatism	45(12.0)	89(12.7)	134(12.4)
Total	376 (100)	702 (100)	1078 (100)

($\chi2 = 9.357$, df = 3, p = 0.024)

Figure 2: Distribution of refractive pattern by gender



4. Discussion

Uncorrected refractive errors and other visually impairing conditions in school children can hinder education, personality development and career opportunities. Additionally, they can impose significant economic burden on the family and society. Childhood blindness is one of the priority conditions targeted in VISION 2020: The Right to Sight Initiative of the World Health Organisation.[7]

Knowledge of the prevalence of refractive errors among school children can help the relevant authorities to plan and provide eye care in the particular geographical area. Present study attempts to provide this information.

Using cycloplegic refraction tends to reveal otherwise latent hyperopia especially in children with a high accommodative amplitude. This therefore leads to higher proportion of hyperopia and hence the prevalence of refractive error. This is different from the noncycloplegic refraction used by Mabaso *et al*[8] and Adegbehingbe *et al*[9] in their respective studies of school children in South Africa and Nigeria.

Refractive error was found in 24.6%of the subjects, astigmatism being the most common followed by myopia and hyperopia. This figure is low when compared to studies on comparable groups from other regions of the world [6,10-12].Our finding is similar to a prevalence of 22.1% among school children aged 7–15 years in Cairo [13]. In another study from South India, a higher (32%) prevalence rate of refractive errors among school children of age 3-18 years as compared to the present study was observed [14].

In present study, out of 265 children with refractive errors, 75(28.3%) children were already using spectacles while the rest were not aware of the presence of the problem. Barriers to the use of corrective spectacles include lack of child and parental awareness of the vision problem, attitudes regarding the need for spectacles, spectacle cost, cosmetic appearance, peer pressure and concerns that wearing glasses may cause progression of refractive error [15].

From a public health perspective, vision screening is an appropriate strategy to reduce vision impairment. Most of this impairment is caused by refractive error, for which treatment is simple and cost- effective.

From our study, we can conclude that refractive error is a significant cause of visual impairment among school children in the North-West Rajasthan. We therefore recommend that cost-effective strategies for vision screening of school children should be incorporated into the school health programmes to prevent devastating impact of visual impairment on a child's education and development. School teachers should also be educated about identification of subjects with low visual acuity and hence refractive error and to guide parents to seek appropriate medical advice at earliest. Parents of school children should be counselled about importance of timely follow up and likelihood of progression of myopia and importance of visual hygiene.

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