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ORIGINAL RESEARCH

Spectrum of Uncorrected Refractive error in School going Children in Rajkot District of Gujarat Region

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ABSTRACT

Context/Background: Uncorrected refractory error in children is the second leading cause of visual impairment in school-aged children, leading to isolation, low education, economic decline, and poor quality of life. **Aims/Objectives:** The objective was to determine the prevalence of uncorrected refractory error and evaluate the distribution and pattern of uncorrected refractive error in school-going children in the Rajkot district of Gujarat state. **Methodology:** A hospital-based cross-sectional study was carried out on 500 school-going children of both genders of age group 5 years to 16 years selected by non-probability convenient sampling and underwent detailed visual assessment and ophthalmic examinations including measurement of uncorrected visual acuity, best corrected visual acuity, auto-refraction, and detailed squint evaluation, if present. Those found to have refractive errors were evaluated and categorized according to the type of refractive error. Statistical analysis was done using the chi-square test and the p-value was determined. **Results:** The prevalence of uncorrected refractive error was 28% with the mean age of children being 9.81± 2.72 years (range, 6 to 14). Astigmatism (73.6%) was the most common refractive error, followed by myopia (15%) and then hypermetropia (11.4%). No significant gender-based difference ($p>0.05$) in the prevalence of uncorrected refractory error was and the prevalence significantly ($p<0.01$) increased with age. **Conclusions:** The prevalence of uncorrected refractive error among school-going children is very high and is now emerging to be the commonest cause of treatable visual impairment. Early detection and management by increasing screening efforts in an organized manner is needed to be done to prevent the prevalence of lifelong visual morbidity due to uncorrected refractory error.

INTRODUCTION

Worldwide, Visual impairment due to uncorrected refractive errors is one of the most common problems in all age groups especially affecting the school going children's and the second leading cause of treatable blindness in developing countries like India 1. Approximately 42% cases of visual impairment cases worldwide are due to uncorrected refractive error with estimate global prevalence of 0.96% 2,3 .It was expected that moderate to severe vision impairment due to uncorrected refractory error will rise by 10% (approx.128 million) and blindness attributable to uncorrected refractory error will rise by 8% (approx.8 million by year 2020 4. Uncorrected refractive error remains a major public health challenge in VISION 2020 initiative despite the availability of cost effective methods such as providing spectacles at primary care level.1

Uncorrected refractive error impairs the vision related quality of life (QoL) of millions of people of different ages, gender, ethnicities and they impose heavy burden on the families of affected individuals as well as the society as a result of loss of manpower. Uncorrected refractory error has great impact on global economy compared to other causes of moderate to severe visual impairment and blindness2,4. A study showed approximately US$268.8 billion per year is lost from uncorrected refractory error and in southeast Asia, South Asia and East Asia bear burden of US$ 244 Billion loss per year from uncorrected myopia 4. Moreover, uncorrected refractive errors at younger ages can lead to reduced educational opportunities affects the ability to function optimally, socialise and engage in activities of daily living such as participation in outdoor sport activities requiring good vision and emotional well-being, which ultimately

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results in increased association with depression, anxiety and frustration. which negatively affects their educational, occupational and athletic performances forming a viscous cycle. 5,6 The data in the present study could be used to enhance screening efforts in an organised manner in those health-care groups which come in regular contact with infants and young children. This includes village health workers, personnel at mother and child care clinics, paediatricians both in practice and in referral hospital services and general practitioners associated with school health programmes. Providing appropriate training to these personnel and incorporating their services could aid early detection and rehabilitation of patients. An ophthalmic referral to ophthalmologists in preschool children by paediatricians for assessment of visual acuity and the fundus, could be a key for early detection of uncorrected refractory error.3,5,6

MATERIALS & METHODS

Study Design, Setting, and Duration: This was a hospital-based cross-sectional study done at Pandit Deendayal Upadhyay Government Medical College, Rajkot district of Gujarat region. The duration of the study was from November 2019 to February 2021 as part of the School eye screening program.

Study Population and sampling technique: The study included school-going children (Age group: 5 to 16 years) attending the Outpatient Department of Pandit Deendayal Upadhyay Government Medical College, Rajkot, and were selected through a non-probabilistic convenient sampling. Children with any ocular lesions (involving anterior and posterior segments), any prior ocular surgery, with a manifest squint, or whose parents/guardians did not give consent were excluded from this study.

Sample size: All the children attending the outpatient department of Pandit Deendayal Upadhyay government medical college, Rajkot during the study period and meeting the inclusion criteria were included in the study.

Data Collection: Data was collected during OPD hours in structured proforma that contained questions regarding vital information of the patient such as name, age, gender, address, School name, and OPD registration number in the initial part followed by questions related to their chief complaints like duration of vision loss as noticed by patient, age at presentation, onset of strabismus and subsequent treatment for it (if any), any previous treatment, etc. followed by detailed past history of any injury, foreign body fall or other ocular pathology, particularly corneal pathology and medical treatment or surgery (if applicable). Detailed personal history was also taken such as any significant birth history or history of diabetes, high blood pressure, asthma, ischemic heart disease, drug resistance, addiction, etc. If any family history of amblyopia or strabismus present or absent was enquired.

All the past medical records if present, were also reviewed. After that detailed ocular examination was performed that included recording the patient's visual acuity and best-corrected visual acuity for each eye by an optometrist using Snellen's self-illuminated vision drum while the patient was seated at a distance of 6 m. A child with visual acuity <6/12 in either eye was declared to have defective vision. After visual acuity assessment, a slit lamp examination was done by an ophthalmologist to rule out any anterior segment pathology followed by examining ocular position and ocular movements in all gaze with a torch light to rule out any strabismus. Strabismus examination if any, was done with Hirschberg's test and confirmed by cover uncover test, and also the angle of deviation was measured with prism bar cover test and Krimsky's prism bar test was done, and then assessment of the binocular status of the eye was performed whenever possible with help of worth's four dot test done. Objective refraction was done using the Huvitz auto refractokeratometer followed by subjective refractive correction done by the optometrist. Those children in whom visual acuity was not improving in either eye to 6/6 after subjective correction, were subjected to refraction under the patient's age-appropriate cycloplegia using cycloplegic drops at every 10 min interval for 3 times followed by streak retinoscopy and detailed fundus evaluation including fixation pattern using direct ophthalmoscope and then children were called for post mydriatic test after 3 days for determining best corrected visual acuity. To maintain uniformity, examination was performed by single optometrist and ophthalmologist. Based on the findings of retinoscopy and post mydriatic examination children were evaluated according to type of refractive error.

Patients with visual acuity of 6/6 and no refractive errors confirmed by reading retinoscopy were excluded from further study.

A spherical equivalent of -0.5 dioptre (D) or more was defined as myopia, +1D or more was defined as hypermetropia, and a cylinder refraction greater than 0.5D was considered as astigmatism. The severity of astigmatism was defined as low astigmatism (0.5-1.5D) and high astigmatism (≥1.5D). To analyze the axis of astigmatism, those with astigmatism >0.5 D were included. The astigmatism axis was classified as With-The-Rule (WTR) if the axis was between 150° and 180° or between 0° and 30°, against-the-rule (ATR) if the axis was between 60° and 120° and oblique (OBL) if was at any other meridian.

Data processing and Analysis: Data entry was done in MS Excel and Chi Square test was done to determine significance of difference in refractory error between male and female and also to analyse difference in refractory error among different age groups. A p-value <0.05 was considered significant.

Results

A total of 500 school-going children were enrolled in the study, out of which 221(44.2%) were females and

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279 (55.8%) were males. The mean age of children was 9.81± 2.72 years (range, 6 to 14). The prevalence of uncorrected refractive error was 28% (140 children out of 500 children had defective vision) and in the remaining 360 children unaided visual acuity was 6/6 on Snellen's chart. Out of 140 children with defective vision, 103 children (73.46%) had normal visual acuity in at least one eye, and 37 children (26.54%) were having defective vision in both eyes.

In all these 140 children cycloplegic refraction was carried out with cyclopentolate 1% eye. After subjective refraction was performed to achieve the best corrected visual acuity, the bilateral defective vision was reduced by 2.5% (n=13) and unilateral defective vision was reduced to 3.9%(n=17) and no child was bilaterally blind in our study. There was an increase in the prevalence of uncorrected refractory error from 25% in the age group 5-7 years to 41.4% in the age group 11-14 years and this difference was statistically significant (p<0.01) (Table-1).

The prevalence of myopia and hyperopia in our study was 15% (n=21) and 11.2% (n=16) respectively. Among the myopes (n=21), 76.4%(n=16) were female and 23.6% (n= 5) were male. Unilateral myopia was seen in 66.98% (n=14) children, while 33.02%(n=7) had bilateral myopia. Myopia was found more in females compared to males, but the difference was not statistically significant (p=0.52).

Among hyperopic, (n=16), 60.33% (n=10) were female and 39.67% (n=6) were males. Unilateral hyperopia was seen in 64.24% (n=11) children, while 35.76% (n= 5) had bilateral hyperopia. It was found in our study that girls were more often hyperopic than boys which was not statistically significant (p=0.65).

The prevalence of astigmatism was 73.57% (n=103). Approximately 93.2% (n=96) patients were having small astigmatism (0.5D-1.5D), while the remaining 6.8% (n=7) had higher astigmatism (≥ 1.5D). There was no statistically significant difference in astigmatism between gender(p=0.67) and age groups (p=0.41) in case of high or low astigmatism. About 80.58% (n=83) patients had the rule astigmatism, while 19.42% (n=20) patients had against the rule astigmatism. With advancing age, WTR astigmatism shows an increasing trend while ATR astigmatism showed a decreasing trend. (p=0.002) (Table-2)

Myopic astigmatism (60.81%) was more prevalent in children

Table 1: Age wise distribution of type of astigmatism

Age groups (in years)	With the rule astigmatism	Against the rule astigmatism	P -value
5-7 (n=48)	78.5%(n=38)	12.8%(n=6)	P=0.002
8-10 (n=30)	81%(n=24)	11% (n=3)	
11-14 (n=25)	84%(n=21)	12% (n=3)	

Table 2: Distribution of patients with astigmatism according to refractive types.

Type of astigmatism	Number of patients
Myopic astigmatism (simple and compound)	63 (60.81%)
Hypermetropic astigmatism (simple and compound)	36 (34.93%)
Mixed astigmatism	4 (4.23%)

Than hyperopic astigmatism (34.93%) and this difference was statistically significant (p=0.034). (Table -3)

Table 3: Age-wise distribution of type of refractory error

Age groups (in years)	Total Refractive error (n=140)	p-value
5-7	25%(n=35)	P <0.01
8-10	33.6%(n=47)	
11-14	41.4%(n=58)	

DISCUSSION

Prevalence of uncorrected refractive error, especially astigmatism was drastically higher in our study. In our study prevalence of uncorrected refractive error was 28%. In study conducted by Padhye et al 7in 2009 prevalence was found to be 5.46% in urban population. In study by Hashemi et al. in rural areas of Iran, prevalence was found to be 18.94%. In study conducted Bhutia KL et al.8in school going children in east Sikkim, prevalence was found to be 6.7%. Overall prevalence of refractive error varies from 5.6% in Kamath et al study, 6.43% in study done by Niroula et al9, 6.94% in Singh et al 10 ,7.57% Roopa naik et al11, 11.9% prevalence in cross sectional study done by Shrestha et al12, 22% in Gupta et al13. Compared to other studies reason for such high prevalence of uncorrected refractive error in our study was firstly, due to lack of knowledge and awareness among the parents/guardians about uncorrected refractory error and its implications. Secondly, may also be associated with neglecting attitude among the parents/guardians especially in rural population because of associated social stigmas. Thirdly, Studies have shown that considerable percentage of vision impairment is related to uncorrected refractive errors.

The most common refractive error in our study was astigmatism (73.5%) followed by myopia (15%) and hyperopia (11.2%). In contrast other studies like Mutti

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et al observed that among the eighth-grade children, the prevalence of myopia was 18.3% and hyperopia was 7.7% In Niroula et al9 study, prevalence of myopia was (4.05%), hyperopia (1.24%) and astigmatism (1.14%). In a meta-analysis done by Castagno et al14 prevalence of hyperopia was 2- 3% between age 9 and 14. Study conducted by Medi K et al.15 in Kampala district showed that the commonest refractive error was astigmatism (52%), followed by hypermetropia (37%) children and myopia (11%) .Also in study of Prevalence of refractive errors in school children of Tafila city conducted by Hussein A et al.16 it was found that myopia (63.5%) was the most common type of refractive error followed by hypermetropia (11.2%) and astigmatism (20.4%).

There was increase in prevalence of uncorrected refractory error with age groups. Our results were comparable with the study conducted by Matta S et al.17 who also found that refractive error increased with increasing age especially in the age group of 10-14 years. Pavithra et al.18 in Bangalore which showed the prevalence of refractive error more (7.5%) in the 13 -15 years age group compared to 6.6% in the 7-9 years age group. A study conducted in Ahmedabad city by Sethi S. showed that the prevalence of refractive errors was highest (40%) in 17 years old students compared to only 6.7% in 11year old children.19

There was no significant difference in the prevalence of myopia, hypermetropia and astigmatism between males and females in our study. ($p>0.05$). Similar results were shown in a study conducted by Triveni C. et al 20. Hypermetropia was shown to be associated with female sex in some of the previous studies by Sethi S. and by Pankaj Kumar et 21 al in a study conducted by Pune. Hypermetropia was equally prevalent in both sexes (50%), astigmatism was found only in females (100%) and myopia was shown to be associated with female gender 65% and having a father with higher level of schooling in a study conducted in Kolkata.22 Myopia was shown to have no sex predilection in studies by Sethi S. and also in study done at Villupuram & Puducherry.23

Prevalence of astigmatism was very high in our study in comparison to other studies done. This high percentage can be attributed to different environmental factors in our state like dust, sun, dirt which may lead to excessive rubbing of eyes predisposing to more astigmatism These differences in astigmatism prevalence rate may also be due to the differences in the characteristics of participating students (age, refractive error, etc.) and the method of measuring cylinder power. We believe this high prevalence rate of astigmatism in our study may be due to the high prevalence rate of myopia (15% with spherical equivalent of − 0.5 D or worse) in our study population. It was consistent with study done by Wang J et al.24 and by Hashemi et al 25

In different Asian and Indian studies percentage of prevalence of astigmatism varied from 13 per cent to 30% or higher depending on the age or ethnic groups.

In our study there is no significant difference of astigmatism between boys and girls (p value=0.67)). The WTR astigmatism is more than the ATR astigmatism. With advancing age WTR astigmatism showed the increasing trend and it was consistent with other studies.26,27,28 .It may be due to weakness in eyelid muscles which results in decrease pressure over eye.29

CONCLUSIONS

High prevalence of uncorrected refractory error in our study concludes that uncorrected refractory error is leading cause of visual impairment in school going children of middle- and low-income countries. This warrants implementation of visual screening programs for children with appropriate clinical and social settings for early detection of these uncorrected refractory error and prevent lifelong visual morbidity.

Our study also emphasizes on need for prescribing them with correct spectacles at appropriate time at no cost, through government and non-governmental collaborative fund and educating their parents about eye health and red flag signs and encouraging more schools to conduct school health programme.

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