Original Research Article

An observational study to evaluate the prevalence and pattern of refractive errors in children aged 3-17 years in Mumbai, India

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ABSTRACT

Background: Refractive error is one of the most important causes of avoidable visual impairment. Early detection of refractive error in children is essential to avoid any permanent disability. The objective of the study was to determine the prevalence and pattern of refractive errors as per age, gender and educational standard in school children aged 3-17 years.

Methods: This was an observational non-interventional study. 600 eyes of 300 participants in the age group of 3-17 years were evaluated. All underwent cycloplegic refraction followed by objective refraction. Participants were divided into 3 groups as follows 3-8 years, 9-12 years and 13-17 years and evaluation of type of refractive error was done age wise and gender wise.

Results: The number of male and female participants was almost similar with a male:female ratio of 1.02:1. Refractive errors were most common in the age group of 9-12 years. The most common refractive error was astigmatism followed by myopia and hypermetropia. It was also found that majority of patients had bilateral refractive errors.

Conclusions: The most common refractive error was astigmatism followed by myopia and hypermetropia. It was also found that majority of patients had bilateral refractive errors. The visual acuity in majority was 6/18 which according to WHO classification falls in Category 0 of Visual impairment in India.

Keywords: Astigmatism, Childhood blindness, Hypermetropia, Myopia, Refractive error

INTRODUCTION

Refractive error is one of the most important causes of avoidable visual impairment. It affects people of all age group and socio-economic rank. Refractive errors cause the light to be brought to focus in front of or behind the retina due to an intrinsic optical defect leading to decreased vision.[1] Refractive errors are usually detected at an early age. Also, the number of blind-person-years due to refractive error in developing countries is nearly twice as that of cataract related blindness.[2-4] A large portion of children's daily activities, particularly related to playing, writing, reading require good visual skills.[5] An estimated 19 million children are vision impaired. Of these, 12 million children have a vision impairment due to refractive error. In the age group 5-15 years, non-correction of refractive errors is due to several factors: the lack of screening, and the availability and affordability of refractive corrections are the most important. However, cultural disincentives also play a role, as shown in surveys from countries where routine screening and provision of corrections are free of charge or easily accessible, but compliance remains low.[6]

The refractive errors are especially common among children as they do not complain and adjust with circumstances. VISION 2020- The Right to sight, initiative to eliminate avoidable blindness has given high

priority to correction of refractive error and has placed it within the category of "childhood blindness". Vision defects due to myopia typically appear during school years. It is the commonest refractive error in school going children and its timely and proper correction saves permanent disability.[7]

Thus, uncorrected refractive errors are the main cause of low vision which hampers performance at school, reduces productivity and impairs quality of life. School children aged 12 - 15 are considered a high-risk group because at this point hyperopia is stabilizing, myopia is setting in and puberty and near work effects begin to exert their influence on refractive error pattern development. School children constitute an ideal group for study of refractive errors because most of them (more than 80%) go to school, easily accessible and offer excellent opportunity for services and health education.[8]

The most common types of refractive errors are myopia, hyperopia, presbyopia, and astigmatism.[9] One of the easiest interventions to treat refractive errors, spectacles, are readily accessible and cost effective, but refractive errors are often not diagnosed or referred. The objectives of the study were to determine the prevalence of refractive errors and pattern of refractive errors as per age, gender and educational standard in school children aged 3-17 years.

This present study was an attempt to find out the prevalence of refractive errors among school children in Mumbai and its association with age, gender and educational standard.

METHODS

This was a prospective follow up study for determining the prevalence of refractive error in school children. Pattern of refractive error as per age, gender and educational standard was analyzed. The study was conducted in 300 children who presented to Ophthalmology OPD of a tertiary care hospital over two years. Before initiating the study, the investigator obtained approval from IEC.

The inclusion criteria for the study were patients of either gender and age above of 3 years and below 18 years, patient whose visual acuity was less than 6/9 in either of the eyes and LAR willing to give voluntary informed consent.

Patients having low vision due to ocular problem other than refractive error were excluded from the study. When the patient came to Ophthalmology OPD for routine ophthalmological examination after their screening has been done in their school or in the OPD itself having visual acuity less than 6/9 and if the patient fulfilled the eligibility criteria, he/she was approached and the Legally Acceptable Representative(LAR) was counseled about the study. When the patient visited the OPD, her/his

visual acuity was recorded using Snellen's Chart at six meters. If the visual acuity of the patient was less than 6/9, he/she was assessed for eligibility criteria for the study and a consent form was provided to the LAR.

If the patient agreed to participate in the present study, her/his retinoscopic examination was performed under dilatation. Children aged between 3 to 5 years were dilated using Atropine 1% eye ointment. Children aged between 6 to 12 years were dilated using Homatropine eyedrops and 13 to 17-years children were dilated using Tropicamide eyedrops.

Atropinised patients, participants dilated with Homatropine and participants dilated with Tropicamide were followed up on Day 21, Day 14 and Day 3 respectively to undergo the post mydriatic test using Snellen's Chart for correction of refractive error. Demographic details like registration no., age, gender and educational status were recorded.

The recruited participants after their screening were divided as per their age and gender for analysis of refractive errors. The patient's visual acuity, retinoscopy and post mydriatic test were done to assess the type of refractive error (myopia, hypermetropia or astigmatism). The prevalence was calculated by seeing the total number of school children screened and amongst them what percentage had refractive error. All the study records were kept confidential and the identity of the participants was not revealed in anyway.

Definition of variables used in the study are summarized in Table 1 and Table 2.

Table 1: Classification used for myopia.

Description	Dioptres of myopia
Low myopia	< -3.25
Moderate myopia	-3.25 to -6.00
High myopia	> -6.00

Table 2: Classification used for hypermetropia.

Description	Dioptres of Hypermetropia
Low Hypermetropia	<+2.25
Moderate Hypermetropia	+2.25 to +5.00
High Hypermetropia	>+5.00

Emmetropic eye was defined if neither eye is myopic or hypermetropia.

Statistical analysis

Demographic data that was continuous (age) is expressed as median and range. Categorical data (gender) is expressed as percentage. Continuous variables are presented as mean±standard deviation (SD). The

prevalence was expressed in percentage. The data was analyzed using descriptive statistics in SPSS software version 21.

RESULTS

A total of 300 children between the age of 3 to 17 years with refractive error participated in the study. The mean age of participants was 10.33±3.08 years (mean±standard deviation). Minimum age of the participant recruited was 4 years and maximum age was 17 years. The participants were divided into 3 groups for data analysis according to age group 3 to 8 years, 9 to 12 years and 13 to 17 years. It was found that maximum percentage of refractive errors was in the age group of 9 to 12 years (46%) followed by age group of 3 to 8 years (31%) and the least was in the age group of 13 to 17 years (23%) (Figure 1).
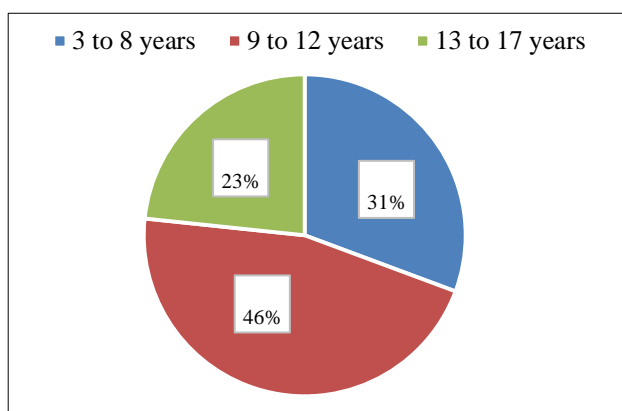

Figure 1: Age wise distribution of participants.

When the data was analyzed gender wise, it was found that the proportion of male and female participants was almost equal. The percentage of male participants being 51% and that of female participants being 49%.

At screening visual acuity of all the participants was recorded and it was found that 66 eyes out of 600 had visual acuity less than 6/60 on Snellen's chart at presentation. Maximum eyes (118 out of 600) had a visual acuity of 6/18 at presentation followed by 6/12 (112 out of 600). 27 eyes out of 600 were emmetropic. Maximum participants had visual acuity of 6/18 at presentation. Out of the 300 participants, the majority (277 participants) had refractive error in both the eyes as compared to 23 participants having refractive error in one eye only.

Analysis of refractive error in participants in whom both eyes (555 eyes) were involved revealed that maximum number of eyes had astigmatism (48.82%) followed by myopia (29.72%) and hypermetropia (21.44%). Out of these 51 eyes were amblyopic. The most common cause of amblyopia was found to be astigmatism in 21 eyes followed by myopia in 17 eyes and hypermetropia in 13 eyes. Analysis of refractive error in participants in whom either of the eyes (45 eyes) were involved revealed that

maximum number of eyes had astigmatism (60%) followed by hypermetropia (35.5%) and myopia (4.44%). Out of these 36 eyes were amblyopic. The most common cause of amblyopia was found to be astigmatism in 22 eyes followed by hypermetropia in 8 eyes and myopia in 6 eyes.

Out of the 298 eyes found to have astigmatism, 126(42.28%) had Simple myopic astigmatism (simple MA), 83 (27.85%) had Compound myopic astigmatism (Compound MA), 61 (20.46%) had Mixed astigmatism, 16 (5.3%) had Simple hypermetropic astigmatism, 12 (4.02%) had compound hypermetropic astigmatism

Amongst myopics; it was found that 30.13% had low myopia, 18.87% had high myopia and 15.7% had moderate myopia. Amongst hypermetropics; it was found that 21.5% had low hypermetropia, 7.2% had moderate hypermetropia and 6.6% had high hypermetropia.

Age wise analysis

Total 92 out of 300 participants (30.66%) belonged to age group of 3 to 8 years. In this age group, maximum number of eyes had astigmatism (45%) followed by myopia (29%) and hypermetropia (26%). 138 out of 300 participants (46%) belonged to age group of 9 to 12 years. Analysis of refractive error in participants 265 eyes were involved revealed that maximum number of eyes had myopia (42%) followed by astigmatism (36%) and hypermetropia (22%). Only 70 out of 300 participants (23.33%) belonged to age group of 13 to 17 years.

Analysis of refractive error in participants 131 eyes were involved revealed that maximum number of eyes had myopia (48%) followed by astigmatism (31%) and hypermetropia (21%).

Gender wise analysis

Statistically 152 out of 300 participants (51%) were males, 16 eyes out of 304 were emmetropic. Analysis of refractive error in participants 288 eyes were involved revealed that maximum number of eyes had myopia (42%) followed by astigmatism (33%) and hypermetropia (25%).

Total 148 out of 300 participants (49%) were females, 7 eyes out of 296 were emmetropic. Analysis of refractive error in participants 289 eyes were involved revealed that maximum number of eyes had astigmatism (42%) followed by myopia (37%) and hypermetropia (21%).

DISCUSSION

Prevalence of refractive error

In present study, it was found that the prevalence of refractive errors among children attending Ophthalmology OPD was 24.28%. According to a

systematic review conducted on the studies in India on refractive errors in children, the overall prevalence was found to be 8%.[10] The present study is hospital-based study, hence the likelihood of patients having refractive error is high as they are already screened and referred from schools or are having ocular complains.

Age and gender distribution

In this study out of 300 patients, there were 152 (51%) boys and 148 (49%) girls with ratio of 1.02:1. This shows almost equal preponderance of boys and girls for refractive errors. In an observational study conducted by Padhye et al found that the male and female percentage was 58.5% and 41.5% and 58.3 and 41.7 respectively with the male:female ratio of 1.4:1 and 1.39:1 respectively.[11] A cross-sectional study was conducted in urban and rural schools of Surendranagar district of Gujarat state in the age group of 10-16 years in 2017. On looking at the prevalence of refractive errors gender wise, boys had 53.67% prevalence in comparison to girls (46.33%) with a male to female ratio of 1.15:1.12 Children in the age group of 3-17 years were included in the study. In this study children in the age group of 9 to 12 years (46%) were affected most followed by age group of 3 to 8 years (31%) and the least was in the age group of 13 to 17 years (23%).

Age wise analysis

In this study 92 out of 300 participants (30.66%) belonged to age group of 3 to 8 years. Maximum number of eyes had astigmatism (45%) followed by myopia (29%) and hypermetropia (26%), 138 out of 300 participants (46%) belonged to age group of 9 to 12 years, maximum number of eyes had myopia (42%) followed by astigmatism (36%) and hypermetropia (22%), 70 out of 300 participants (23.33%) belonged to age group of 13 to 17 years, maximum number of eyes had myopia (48%) followed by astigmatism (31%) and hypermetropia (21%).

In a study conducted at Gondar district of Northwest Ethopia to study the prevalence of refractive error in elementary school children the highest rate of refractive errors were found in the age group of 10-14 years. Hyperopia was common in the age group between 5 years to 9 years. However, for 10 to14 year olds, myopia was more prevalent; the same was true for the 15 years to 19 years age group.[13]

Gender wise analysis

In the study, 152 out of 300 participants (51%) were males, 16 eyes out of 304 were emmetropic. Analysis of refractive error in participants 288 eyes were involved revealed that maximum number of eyes had myopia (42%) followed by astigmatism (33%) and hypermetropia (25%). 148 out of 300 participants (49%) were females, 7 eyes out of 296 were emmetropic. Analysis of refractive

error in participants 289 eyes were involved revealed that maximum number of eyes had astigmatism (42%) followed by myopia (37%) and hypermetropia (21%). That is, the prevalence of refractive errors was slightly higher in the female participants as compared to males.

In a study conducted by Yared et al there was a greater preponderance of refractive error in females and in the 10 years to 14 years age group compared to males and other age groups respectively. Amongst the males, maximum number of eyes had myopia (42%) followed by astigmatism (33%) and hypermetropia (25%). Among males, myopia was the common refractive error. Amongst females, it was found that, maximum number of eyes had astigmatism (42%) followed by myopia (37%) and hypermetropia (21%).[13] Wadaani et al found that myopia was the most commonly encountered refractive error among both genders (65.7% of the total errors encountered).[14]

CONCLUSION

In the present observational study, the number of female and male participants was almost similar with a male: female ratio of 1.02:1. Refractive errors were most commonly found in the age group of 9-12 years, this might be an indicator of children able to perceive their problems and communicate about it after reaching a certain age. The most common refractive error was astigmatism followed by myopia and hypermetroia. In myopics it was found that low myopia i.e <3.25 sphere was most common. This highlights the need for routine ophthalmological evaluation of children and their proper assessment and management. It was also found that majority of patients had bilateral refractive errors, this may be a pointer towards genetic roleplay in the etiology of refractive errors. The visual acuity in majority was found to be 6/18 which according to WHO classification falls in Category 0 of Visual impairment in India.

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