Original articles

The distribution of refractive errors among children attending Lumbini Eye Institute, Nepal

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Abstract

Introduction: Uncorrected refractive error is an important cause of childhood blindness and visual impairment.

Objective: To describe the patterns of refractive errors among children attending the outpatient clinic at the Department of Pediatric Ophthalmology, Lumbini Eye Institute, Bhairahawa, Nepal.

Subjects and methods: Records of 133 children with refractive errors aged 5 - 15 years from both the urban and rural areas of Nepal and the adjacent territory of India attending the hospital between September and November 2010 were examined for patterns of refractive errors. The SPSS statistical software was used to perform data analysis.

Results: The commonest type of refractive error among the children was astigmatism (47 %) followed by myopia (34 %) and hyperopia (15 %). The refractive error was more prevalent among children of both the genders of age group 11-15 years as compared to their younger counterparts (RR = 1.22, 95 % CI = 0.66 – 2.25). The refractive error was more common (70 %) in the rural than the urban children (26 %). The rural females had a higher (38 %) prevalence of myopia than urban females (18 %). Among the children with refractive errors, only 57 % were using spectacles at the initial presentation.

Conclusions: Astigmatism is the commonest type of refractive error among the children of age 5 - 15 years followed by hypermetropia and myopia. Refractive error remains uncorrected in a significant number of children.

Key-words: refractive errors, astigmatism, myopia, children, visual impairment

Introduction

Refractive error is a state in which the optical system of a non-accommodating eye fails to bring parallel rays of light to focus on the retina (The Eye Diseases Prevalence Research Group, 1996). Childhood visual impairment due to refractive errors is one of the most common problems in school children and is internationally the second leading cause of treatable blindness (Dondona & Dondona, 2001). In recent years, numerous studies have examined the prevalence of refractive errors such as

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myopia, hyperopia, amblyopia and astigmatism in school children and adults (Bengtsson & Grodum, 1999). The 1971-1972 National Health and Nutrition Examination Survey found that 25% of the 12-54 year-old population of the United States was myopic (Mutti & Zadnik, 2000), and more recently, using identical protocols, population-based refractive error surveys in children have been conducted in China, Nepal and India (Zhoa, 2000). Refractive Error Study in Children surveys were designed to assess the age- and sex-specific prevalence of refractive error and related visual impairment in children of different ethnic origins and cultural settings, using consistent definitions and methods and thereby providing directly comparable data from entirely different parts of the world (Negrel et al, 2000)

Two studies from Malaysia showed an increase in the prevalence of myopia with age in children:

A 2003 study (Garner et al, 1987) found a prevalence of myopia in the 7-8 years age group of 4.3 % and 25.6 % in the 15-16 years age group. An older (1985) study (Goh et al, 20010) estimated a prevalence of myopia in school age children that varied from 9.8 % at 7 years of age to 34.4% at 15 years. This latter study also estimated prevalence of hyperopia that decreased with age (3.8 % at age 7 years to less than 1 % by age 15 years).

Astigmatism is very common in early development of human infants and is typically highest at approximately 10 weeks of age and then decreases with age during school years (Gwiazda et al, 1984). Recent estimates of the prevalence of astigmatism are 2.2 % in Nepal (Dandona et al, 1998) and 2.8 % in rural India (Dandona et al, 2002), which are substantially less than estimates of 15 % in China (Zhao, 2000) and 19 % in Chile (Maul et al, 2000). Two studies in Taiwan (Lin et al, 1999) in 1995 and (Shih, 2004) in 2000 of the prevalence and distribution of astigmatism in school children in Taiwan showed that about one third of their astigmatism was < 1D (28 % and 33 %). In 1995, 11 % and in 2000, 13 % had astigmatism between 1.0 and 2.0D. Less than 2 % of students had astigmatism >3.0 D (1.3 % in 1995 and 1.8 % in 2000). Most astigmatism was with-the-rule: 83 % in 1995 and 90 % in 2000. Only 17 % of children in 1995 and 10 % in 2000 had against-the-rule astigmatism (Shin, 2004).

Very few studies of the prevalence and distribution of refractive errors (myopia, hyperopia and astigmatism) among children in the western part of Nepal have been conducted. This study aims to remove the lacunae and to inform future planning for eye care programs to reduce the burden of visual impairment due to refractive error among younger population in this area.

Subjects and methods

This study examines records of children with refractive errors aged 5 - 15 years who attended the Pediatric Department of Lumbini Eye Institute between September and November 2010. All children presenting were included, except those with other ocular problems such as corneal opacities, corneal dystrophies, cataract, congenital glaucoma, vitreous opacities, ocular trauma and conjunctivitis.

Vision was measured with the child wearing their glasses if the child already had glasses on presentation. All children underwent the following examinations in the following sequence: visual acuity measurement of each eye separately (unaided and with a pin-hole), extra-ocular movement assessment, cover test, cover-uncover test, anterior segment examination with a loupe and a torch light, refraction using a Heine retinoscope, and fundus examination using a direct ophthalmoscope. Visual acuity was measured with a Snellen letter optotype.

Cycloplegic refraction was done using 1% Cyclopentolate and 1 % Tropicamide eye drops applied in a C-T-C pattern, with five minutes between applications (CTC protocol). Cycloplegia was considered complete if the pupils were dilated more than 6 mm. Refraction was performed using a streak retinoscope in a semi dark room at a dis-

tance of 50 cm. The data were recorded and analyzed using the SPSS statistics program.

Refractive errors were classified according to the following definitions (Rainaldo et al, 2006).

a) Hyperopia: Refractive error at least +0.50D. This was further classified as low (+0.50D to < +3.0 D), medium (+3.0 D to < + 6.0D) and high hyperopia (+ 6.0D or higher).

b) Myopia: Refractive error of at least -0.50D. This was further classified as low (-0.50D to < -3.0D), medium (-3.0 D to < -6.0 D) and high myopia (-6.0D or higher).

c) Astigmatism: Astigmatism was classified as simple hyperopic astigmatism (SHA), simple myopic astigmatism (SMA), compound hyperopic astigmatism (CHA), compound myopic astigmatism (CMA) and mixed astigmatism (MA).

Results

Of the 4187 children who attended the clinic during the study period, among 199 children with refractive errors, 133 children (58 % males) were selected in the study and were included for further statistical analysis. Details of the children and their eyes are listed in Tables 1 and 2. In particular, note that 98 (74 %) of the children came from rural areas (of which 45 % were female), and 35 (26 %) from urban areas (34 % female), and that children in the 11-15 year age group had refractive errors more prevalent (66 %) and most of them (47 %) had astigmatism (RR=1.22, 95% CI = 0.66 – 2.25).

Table 1
Breakdown of the 133 children by residence, age group and sex

Residence		age group			
		1-5 years	6-10 years	11-15 years	total
Rural	male	3	15	36	54
	female	2	10	32	44
	total rural	5	25	68	98 (74 %)
Urban	male	1	6	16	23
	female	2	2	8	12
	total urban	3	8	24	35 (26 %)

Table 2
Breakdown of 266 eyes of 133 children according to the type of refractive errors and age group

Type of error	1-5 years	6-10 years	11-15 years	total
Emmetropia	0	3	8	11
Low hyperopia	0	1	4	5
Medium hyperopia	0	2	2	4
High hyperopia	4	10	16	30
Low myopia	0	5	40	45
Medium myopia	0	2	14	16
High myopia	0	12	18	30
SHA	2	0	0	2
SMA	2	7	7	16
CHA	2	6	4	12
CMA	4	11	62	77
MA	2	7	9	18
Total	16	66	184	266

The relative risk (RR) of having astigmatism as compared to other types of refractive errors before the age of 10 years is 0.8 (95 % CI = 0.56 – 1.15) which is not statistically significant (p value = 0.2).

Table 3
The distribution of refractive error type in 266 eyes, with residence and gender

	Residence						Total
	Rural			Urban			
	Sex		Rural total	Sex		Urban total	
	Male	Female		Male	Female		
Emmetropia	6	5	11	0	0	0	11
Low hyperopia	1	4	5	0	0	0	5
Medium hyperopia	2	2	4	0	0	0	4
High hyperopia	20	8	28	2	0	2	30
Low myopia	22	12	34	7	4	11	45
Medium myopia	6	9	15	1	0	1	16
High myopia	14	12	26	2	2	4	30
SHA	2	0	2	0	0	0	2
SMA	3	5	8	2	6	8	16
CHA	4	4	8	4	0	4	12
CMA	19	21	40	28	9	37	77
MA	9	6	15	0	3	3	18
Totals	**108**	**88**	**196**	**46**	**24**	**70**	**266**

Table 3 shows that the males had a higher (58 %) proportion of refractive errors than females. It also indicates that the refractive error was more common (70 %) in rural than urban children (26 %), but that rural females had a higher (38 %) incidence of myopia than urban females (18 %).

Table 4
Conditions of 266 eyes with 6-group ethnicity

	Emmetropia	hyperopia	myopia	astigmatism	total
Dalit	0	0	6 (100 %)	0	6
Janajati	3 (4 %)	8 (12 %)	25 (37 %)	32 (47 %)	68
Non-Dalit Tarai	5 (6 %)	8 (10 %)	26 (33 %)	41 (51 %)	80
Religious minorities	0	7 (32 %)	6 (27 %)	9 (41 %)	22
Advantage Janajati	2 (10 %)	2 (10 %)	6 (30 %)	10 (50 %)	20
Upper Caste	1 (1 %)	14 (20 %)	22 (31 %)	33 (47 %)	70
Total	11 (4 %)	39 (15 %)	91 (34 %)	125 (47 %)	266

Table 4 describes the breakdown of the types of the refractive errors of the 266 eyes of the 133 children, using the following ethnic categories as defined by School Eye Health Program, Indo-Nepal, CNNJS, Kathmandu, ordered roughly by increasing social status.

- Dalit (Bishokarma, Damai, Sarki, Dhobi, Chamar) – 3 children (2 %)
- Janajati (Magar, Tamang, Rai, Tharu, Dhimal, Kumal) – 39 children (26 %)
- Non-Dalit Tarai (Yadav, Lodhar, Thakur, Mali, Kumar) – 40 children (30 %)
- Religious minorities (Muslim, Churaute) – 11 children (8 %)
- Advantage Janajati (Newar, Gurung, Thakali) – 10 children (8 %)
- Upper Caste (Brahmin, Chhetriya, Thakuri) – 35 children (26 %)

Table 5
The use of glasses at presentation with type of visit

Type of visit	Yes	no	Total
New	32	29	61 (46 %)
Follow up	44	28	72 (54 %)
Total	76 (57 %)	57 (43 %)	133

Table 5 lists the numbers of patients wearing spectacles at presentation. Overall, only 57 % of 133 patients with refractive error were using spectacles at presentation. The distribution is not statistically significant: A Chi-square test (Fisher's exact test) applied to the above contingency table yielded a *p*-value of 0.38. Patients presenting for a follow-up visit were not statistically more likely to be wearing spectacles.

Table 6
The use of glasses at presentation with location of the patient

Location	Yes	No	Total
Rural	51 (67 %)	47	98 (74 %)
Urban	25 (33 %)	10	35 (26 %)
Total	76 (57 %)	57 (43 %)	133

Table 6 shows that among the children wearing glasses at presentation, 67 % were from rural areas. The distribution is statistically significant (*p*-value = 0.049). Patients presenting with glasses from rural area were statistically more likely to be from the urban areas.

Table 7
log MAR visual acuity of the best eye

VA	Number	Percent
0.00	59	44.36
0.18	43	32.33
0.30	10	7.52
0.40	2	1.50
0.43	2	1.50
0.48	8	6.02
0.50	2	1.50
0.60	2	1.50
0.70	1	0.75
0.78	2	1.50
0.80	2	1.50
Total	133	100.00

Table 7 shows that 7 % children were visually impaired due to refractive error. 24 % of the children had parents who used glasses.

Discussion

Uncorrected refractive errors are a major cause of visual impairment in many countries

(Dandona et al, 1998). In developing countries however, it is often difficult to provide efficient refraction services and this results in a high prevalence of uncorrected refractive errors. This recent study shows that 7 % children were visual impairment due to refractive error. Avoidable blindness and low vision can restrict progress in education, limit motor development in children, affect mobility, limit career opportunities and restrict access to information. It is a burden on the community and its social and income generating services. So there is a priority need to control and prevent these disorders. For this, information about the pattern of refractive errors in the children is essential. It helps in planning effective community programs to deal with the problem.

There are marked differences in the prevalence of certain ocular disorders amongst various racial and ethnic groups. These differences probably reflect the unique genetic make- up of these various groups coupled with a variety of environmental influences. Ethnic variations are particularly marked for the prevalence of refractive errors.

In this study, 47 % children were astigmatism. Out of all kinds of astigmatism, compound myopic astigmatism is the most common in all age groups (Table 2). Myopia is almost equally distributed among Bramins and Chhatriyas ethnic groups. There are a number of investigations to demonstrate the relationship between near work and myopia and myopic astigmatism. The Brahmins have the highest literacy rate in Nepal; most of them are employed in academic and clerical jobs. All these professional jobs demand near work which may be the reason for high percentage of astigmatism especially myopic astigmatism.

This study shows that 24 % of the children were having history of parent wearing glasses. Clinically significant hyperopia or astigmatism is present at birth or at early age. That is why it is presumed that these conditions are hereditary in nature. On the other hand, because myopia is seldom present at birth but becomes evident in late childhood, many researchers believe that it occurs as a result of environmental rather than hereditary factors. However, those who are in favor of hereditary factors often argue that a genetically determined trait does not have to be present at birth.

Conclusions

The majority of children with refractive error are from rural areas of which 45 % are female. The refractive error is more prevalent in the age group of 11-15 years. Most of the children (47 %) have astigmatism. Male children have a higher (58 %) proportion of refractive errors than females.

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