

■ *Original article*

## The patterns of refractive errors among the school children of rural and urban settings in Nepal

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### Abstract

**Introduction:** The uncorrected refractive error is an important cause of childhood blindness and visual impairment.

**Objective:** To study the patterns of refractive errors among the urban and rural school going children of Nepal.

**Subjects and methods:** A total of 440 school children of urban and rural schools within the age range of 7-15 years were selected for this study using multi-stage randomization technique.

**Results:** The overall prevalence of refractive error in school children was 19.8 %. The commonest refractive error among the students was myopia (59.8 %), followed by hypermetropia (31.0 %). The children of age group 12-15 years had the higher prevalence of myopia as compared to the younger counterparts (42.5 % vs 17.2 %). The prevalence of myopia was 15.5 % among the urban students as compared to 8.2 % among the rural ones (RR = 1.89, 95 % CI = 1.1-3.24). The hypermetropia was more common in urban students than in rural ones (6.4 % vs 5.9 %, RR = 1.08 (95 % CI: 0.52-2.24).

**Conclusion:** The prevalence of refractive error in the school children of Nepal is 19.8 %. The students from urban settings are more likely to have refractive error than their rural counterparts.

### Introduction

The uncorrected refractive error prevalence ranges from 0.7 % to 22.3 % and rises with age (Rainaldo D et al 2006). In relation to Nepal, there are about 5.5 million children below 16 years of age. About 3.7 million of them are of school age (5–16 years) (CBS, 2001). The Nepal Blindness Survey conducted in 1981 found relatively few cases of childhood blindness. The main causes of blindness in children in that survey were ocular infections, xerophthalmia and congenital cataract (Brilliant GE et al 1988).

The present study was carried out to find out the patterns of refractive errors in urban and rural school-going children and to compare them.

### Subjects and methods

Randomly identified children of selected urban and rural schools within the age range of 7-15 years were included in this study. Exclusion criteria were the students with other ocular diseases like corneal opacities, corneal dystrophies, cataract, congenital glaucoma, vitreous opacities, ocular trauma and conjunctivitis. The sample size calculated was 400 and was increased by 10 % to cover non-responders. The final sample size determined was 440.

Two government schools each from urban and rural settings (Village Development Committees) of Sunsari District were selected using the lottery method. The desired number of students was obtained from each school using the random number table.

Visual acuity was measured with Snellen letter optotype. Visual loss was classified according to the WHO categories of visual impairment. Whenever

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the visual acuity was found to be <6/12, any improvement of vision with a pin-hole was noted. The vision was also taken with glasses if students were using them.

All the children underwent the following examinations: visual acuity measurement of both the eyes separately ( unaided and with a pin-hole ) and with glasses, if any, extra-ocular movement assessment, cover test, cover-uncover test, anterior segment examination with a loupe and a torch light, and fundus examination with a direct ophthalmoscope.

Cycloplegic refraction was done using 1% cyclopentolate eye drops applied twice two minutes apart. Cycloplegia was considered complete if the pupils were dilated more than 6 mm. Cycloplegic refraction was performed using a streak retinoscope in a semi-dark room at a distance of 0.75 meters. In cases where the visual acuity did not improve with refraction, an effort was made to find out the cause of decreased vision. All the data were recorded on the pre-set eye examination record form. The following definitions were used to classify the refractive error (Rainaldo D et al 2006).

- a) Hypermetropia: refractive error equal to or more than +0.50 D.  
 This was further classified as low hypermetropia (>+0.50D to <+ 3.0D), medium hypermetropia (>+ 3.0 D to < +6.0D) and high hypermetropia (>+6.0D).
- b) Myopia: Refractive error of > - 0.50D  
 This was further classified as low myopia (> - 0.50D to < -3.0D ), medium myopia (>-3.0D to < -6.0D) and high myopia (>-6.0D ).
- c) Astigmatism: any cylindrical error.  
 Astigmatism was further classified as simple myopic astigmatism, simple hyperopic astigmatism, compound astigmatism and mixed astigmatism.

## Results

There was no significant difference between the groups in terms of gender and age (Table 1). There were a total of 220 (50 %) students from the urban area out of which 113 (25.7 %) students were females and 107 (24.3 %) were male. Similarly, out of 220 (50 %) students from rural area 119 (27.0 %) were female students and 101 (23.0 %) were male students. The distribution of students among both the urban and rural areas was homogeneous making the groups comparable (p value=0.567).

**Table 1**  
**Age and gender distribution of the school children**

Age groups (Years)	Sex		Total	P- value
	Female	Male		
7 – 11	104 (23.6%)	105 (23.9%)	209 (47.5%)	0.236
12 – 15	128 (29.1%)	103 (23.4%)	231 (52.5%)	
Total	232 (52.7%)	208 (47.3%)	440	

Out of 220 students from urban area, 114 (25.9 %) were from age group 7-11 years and 106 (24.1 %) were from the age group of 12-15 years. Out of 220 students from rural area, 95 (21.6 %) were from age group 7-11 years and 125 (28.4 %) were from age group 12-15 years. This distribution was homogeneous (p value = 0.086) and thus comparable ( Table 2 ).

**Table 2**  
**Age versus types of refractive errors**

Age groups	*Myopia		**Hypermetropia		Astigmatism		Total	
	n	%	n	%	n	%	(n)	%
7 - 11	15	17.2	20	23.0	0	0	35	40.2
12 – 15	37	42.5	7	8.0	8	9.2	52	59.8
Total	52	59.8	27	31.0	8	9.2	87	100.0

\*P value: 0.011    \*\*p value: 0.014

Out of all children, older children in the age group of 12 -15 years had highest prevalence of refractive error (59.8 % ); and most of them ( 42.5 % ) had myopia.

**Table 3**  
**Myopia in urban versus rural students**

Disease status	Myopia*			Relative Risk (RR)	95% CI of RR	
	Urban	Rural	Total		Lower Limit	Upper Limit
Presence	34(15.5%)	18(8.2%)	52(11.8%)	1.89	1.10	3.24
Absent	186(84.5%)	202(91.8%)	388(88.2%)			
Total	220	220	440			

\*p value 0.018, RR=1.89, 95 % CI: 1.1.-3.24

Myopia was more prevalent (15.5 %) among the urban students than the rural ones (8.2 %), ( Table 3).

**Table 4**  
**Hypermetropia in urban versus rural students**

Disease Status	Hypermetropia			Relative Risk (RR)	95% CI		P value
	Urban	Rural	Total		Lower Limit	Upper Limit	
Present	14 (6.4 %)	13 (5.9 %)	27 (6.1 %)	1.08	0.52	2.24	0.854
Absent	206 (93.6 %)	207 (94.1 %)	413 (93.9 %)				
Total	220	220	440				

**Table 5**  
**Astigmatism in urban versus rural students**

Refractive error	Astigmatism*			Relative Risk (RR)	95% CI of RR		P value
	Urban	Rural	Total		Lower Limit	Upper Limit	
Present	4 (1.8 %)	4 (1.8 %)	8 (1.8 %)				0.675
Absent	216 (98.2 %)	216 (98.2 %)	432 (98.2 %)	1.00	0.25	3.95	
Total	220	220	440				

Prevalence of astigmatism was equal in both urban and rural areas(1.8 %).

**Table 6**  
**Prevalence of refractive error in urban vs rural schools**

Refractive error	Total		Grand total	Relative Risk (RR)	95% CI of RR		P value
	*Urban	*Rural			Lower Limit	Upper Limit	
Present	52 (11.8 %)	35 (8.0 %)	87 (19.8 %)				0.021
Absent	168 (38.2 %)	185 (42.0 %)	353 (80.2 %)	1.26	1.02	1.54	
Total	220	220	400				

It was observed that the overall refractive error in school children was 19.8 %. The refractive error was more common (11.8 %) in urban school children as compared to rural students (8.0 %). This was statistically significant (p value: 0.021). The males had a higher (32.1 %) prevalence of myopia as compared to their female counterparts (27.58 %). The urban females had a higher (17.2 %) prevalence of myopia as compared to rural females (10.3 %, RR= 1.13).

The males had a higher (17.2%) prevalence of hypermetropia as compared to the females (13.8 %). Females from both the urban and rural areas had the same prevalence (6.9 %) of hypermetropia. The urban males had a high (9.1 %) prevalence of refractive error as compared to the rural males (8.0 %, RR=1.08). Females had a greater (5.7%) prevalence of astigmatism as compared to males (3.4%). Rural females had high (3.4 %) prevalence of astigmatism as compared to urban females (2.3%). Urban males had high (2.3 %) prevalence of refractive error as compared to rural males (1.2 %, RR=1.5). Overall, males had a higher prevalence of refractive error (52.9 %) than the females (47.1 %).

Urban females had high (26.5%) prevalence of refractive error as compared to rural females (20.7 %). Urban males had high (33.3 %) prevalence of refractive error as compared to rural male students (19.5 %, RR=1.19). It was observed that myopia was more common (71.2 %) in the older age group (12-15 years) than in younger ones (28.8 %). In both age groups, myopia was more common (19.2 % in 7-11 years; 46.2 % in 12-15 years) in urban students than in the rural ones (9.6 % and 25.0 % respectively, RR=1.05). The younger age groups (7-11 years) had a higher (74.0 %) prevalence of hypermetropia as compared to the older age group (25.9 %).

Among the older age group children, rural ones had a higher (14.8 %) prevalence of refractive error as compared to urban children of the same age (11.1 %, RR=1.28). There was no astigmatism in the younger age group students. An equal number (50 %) of the students in the older age group (12-15

years) from both urban and rural schools had astigmatism.

## Discussion

The Right to Sight: VISION 2020 aims to eliminate avoidable blindness in the world by 2020 and targets the world's leading causes of avoidable visual impairment: cataract, trachoma, onchocerciasis, childhood blindness (including vitamin A deficiency), and refractive error and low vision (Louis P et al 2004).

The reported prevalence of refractive error varies in different areas of the world. Studies concerning the distribution of refractive errors, especially among different age groups, gender and ethnic groups have been recommended. Several studies have been carried out according to the protocol by "Refractive Error Study in Children (RESC) in countries like China, Nepal, Chile, India, South Africa and Malaysia (Rainaldo D et al 2006) .

Prevalence of refractive error ranges from 2.21-18.8 % among the different studies. Studies conducted in Kathmandu (Nepal BP et al 2003) showed the prevalence of refractive error as 8.1 %; myopia: 4.3 %, hypermetropia: 1.3 %, whereas a study in Mechi found the refractive error to be 2.21 % (Pokharel GP et al 2004). Different countries have various prevalence of refractive error, like India (Murthy GV et al 2002): 15.1 %; Chile (Maul E et al 2000): 13.64 %; China (Zhao J et al 2000): 18.8 % ; USA (Zandik K et al 2003): 18.7 %. Higher prevalence of refractive error was found in the economically developed nations as opposed to the less developed ones. The highest prevalence was observed in a study from China (Zhao et al 2000) (18.8 %) and the lowest (2.21 %) was observed in Nepal (Pokharel GP et al 2000). The prevalence of refractive error, particularly myopia, was observed with higher frequency in the Asian countries.

Higher prevalence of refractive errors in these countries is suggested to be a result of more near work. It may be related to the type of sampling method used and the size of population screened. The prevalence of refractive error was found to be 19.77 % in the present study. Myopia was the commonest refractive error, being 11.81 %, followed by

hypermetropia (7.0 %). Astigmatism was the least prevalent type of refractive error.

The study from Mechi (Pokharel GP et al 2000), which was more elaborate, showed the prevalence of refractive error at a mere 2.21 %. The other study (CBS, 2001) from Kathmandu showed refractive error higher than this (8.1 %). Compared to them, the present study revealed a much higher prevalence of refractive error. This may be attributed to the variation of geographical location in all these studies. In all the studies a higher prevalence of myopia was observed than of hypermetropia. The higher myopic rates were observed in the economically self-sufficient societies. This study showed an overall prevalence of myopia of 11.81 % and hyperopia of 7 % which are higher than in the other studies from Nepal (Nepal BP et al 2003, Pokharel GP et al 2000).

Among the myopes and hypermetropes, low grade was the commonest refractive subtype comprising 69.2 % and 88.9 % respectively. The patients with a high grade of refractive error were high myopes comprising 5.7 % . In the present study the younger age group (7-11 years) had a high prevalence of hypermetropia (23.0 %) than the older children (8 %). The children of age group 12-15 years had highest prevalence of myopia (42.5 %) as compared to younger children (17.2 %) of the age group 7-11 years. Astigmatism was exclusively seen only in older children (9.2 %). Several studies carried out all over the world have shown similar results of myopia being more common in the older age group (Morgan A et al 2006, Garner LF et al 1999, Zhao J et al 2000, Maul E et al 2000, Fan DS et al 2004, Saw SM et al 2001, Andrews et al 2003, Donald O et al 2006, Louis T et al 2006).

In this study, refractive error was more common in males (52.9 %) than in females (47.1 %) . Hypermetropia was more common in males (17.2 %) as compared to females (13.8 %), which was statistically significant (p value:0.014). This finding was in contradiction to other several studies which had shown hypermetropia to be more common in females (Morgan A et al 2006, Garner LF et al 1999, Zhao J et al 2000, Maul E et al 2000).

This can be explained by genetic and environmental influence on the refractive error, which can give rise to variation among sexes (Beatriz M et al 2002). In this study, myopia was more common (32.1 %) in males as compared to females (27.58 %), which was statistically significant (p value 0.011). This too is in contradiction to many studies which had shown myopia to be more common in females (Morgan A et al 2006, Saw SM et al 2001, Seang-Mei Saw et al 2002, Andrews et al 2003). This can be explained by the genetic and environmental influence on the refractive error which can give rise to variation among sexes (Beatriz M et al 2002). In this present study females had a higher prevalence (5.7 %) of astigmatism as compared to males (3.4 %).

In the present study, it was observed that in all the age groups refractive error was more common (59.8 %) in urban children as compared to their fellow rural colleagues (40.2 %) which was statistically significant (p value=0.04).

Myopia was more common (39.0 %) in urban students than in rural ones (20.6 %), which was statistically significant (p value 0.02). Similar comparative studies (Zandik K et al 2003, Turalci T et al 1995) too have shown that urban children have more myopia than rural children. A higher educational level (Garner LF et al 1999) and a high parental education (Fan DS et al 2004) may be associated with a higher prevalence of myopia among urban populations.

The higher prevalence of myopia among urban children can be attributed to various contributory factors like increased near-work (computer use and prolonged study hours due to competitive atmosphere in urban areas) (Paul Estes et al 2007, Akbar F et al 2007, Beatriz M et al 2002, Wedner L et al 2008), ambient light exposure (Kovin et al 2002), increased IQ (Richard A et al 2006), and less breast feeding to infants in urban areas.

However, in this study, there was no significant association between myopia and study hours (p value 0.659) None of the students were using computers at home or at schools. This contributory factor could not be evaluated in this study.

One of the studies (Karki & Karki, 2004) had shown that hypermetropia was more common if either of the parents smoked or the mother was a smoker during pregnancy. This factor was also difficult to assess as it could be offending to ask such a question to young students.

Urban females had a higher (17.2 %) prevalence of myopia as compared to rural females (10.3 %). Similarly, urban males had a higher (21.8 %) prevalence of refractive error as compared to rural males (10.3 %). The relative risk of myopia among urban and rural was 1.13 (95 % CI :0.62-2.06). This can be explained by more near-work in urban areas (Paul Estes et al 2007, Akbar F et al 2007, Beatriz M et al 2002, Wedner L et al 2008). In the urban areas, males had a higher prevalence (21.8 %) of myopia as compared to females (17.2 %). This can be explained by the fact that more emphasis for study is imposed on males in our male dominated society.

Males from urban areas had higher (9.1 %) prevalence of hypermetropia than females in the same setting (6.9 %). Similarly males from rural area had higher prevalence (8.0 %) of hypermetropia as compared to females (6.9 %) from the same setting. The relative risk of hypermetropia in urban versus rural area was 1.08 (95 % CI 0.46-2.50). This difference however could not be explained. As expected and discussed above, normal visual status (6/6-6/18) was more common (95.9 %) in rural students as compared to urban children (92.3 %) since they had less refractive errors (Garner LF et al 1999, Fan DS et al 2004, Zandik K et al 2003, Turalcli T et al 1995). As expected visual impairment (<6/18-6/60) was more common (6.4 %) in urban as compared to rural ones (3.7 %). Similarly severe visual impairment (<6/60-3/60) was exclusively seen (1.4 %) among urban children due to various factors leading to ocular morbidity (Paul Estes et al 2007, Akbar F et al 2007, Kovin et al 2002, Richard A et al 2006, Beatriz M et al 2002, Wedner L et al 2008).

Likewise, the older children (12-15 years) of both sexes had more (male:3.0 %, female:5.2 %) prevalence of visual impairment (<6/18-6/60) as compared to younger ones (male:1.4%, female:1.4 %) as shown by many studies (Garner LF et al 1999,

Fan DS et al 2004, Zandik K et al 2003, Turalcli T et al 1995).

It was observed that out of 87 students with refractive error only 21 % were using spectacles which is comparable to the 13.4 % (Morgan A et al 2006), and 30.3% (O Parssinen et al 2004) of spectacle students in various studies.

This low rate of the use of spectacles may be due to the nuisance of wearing them or due to cosmetic reasons when the students may be shy to wear them, others may be unaware of their refractive error problems. This also points towards the negligence of parents and school teachers to motivate students in the proper use of spectacles.

Out of the total wearing spectacles, the maximum (79.0 %) were urban rather than rural (21.0 %). This can be explained by better health awareness among parents and students of urban areas.

## Conclusion

Visual impairment is more common in urban students as compared to rural students. Urban school children have a significantly higher prevalence of refractive error as compared to their rural counterparts. Urban school children have a higher prevalence of myopia and hypermetropia as compared to the rural students.

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