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Original Research Article

Prevalence of Refractive Error and Associated Risk Factors in School-Age Children in Nepal: A Cross-sectional Study

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ABSTRACT:

Introduction: The most common visual disorder in school age children is refractive error globally. The present study aimed to know the prevalence of refractive errors and explore the factors associated with the refractive error in school-age children in Palpa district of western part of Nepal. **Methods:** All the school children were selected between age groups 5 to 18 years from four schools of Palpa by multistage sampling method. After the preliminary examination on visual acuity, the children were referred to the Department of Ophthalmology, Lumbini Medical College, Palpa for confirmation of the refractive errors. **Results:** In school-age children the prevalence of refractive error was 9% of which myopia was the most common (4.05%). Females (about 12%) were more likely to have refractive errors than males (about 7%). The refractive error of males was 0.106 (right eye) and 0.564 (left eye) times more likely than females. The refractive errors were statistically found more common in Dalit students (14.6%) than Brahmin/Chhetri (about 12%) and Janajati (7.6%). The prevalence of refractive errors among students using smart phone/ laptop (about 12%) was higher than those not using (8.36%). **Conclusion:** Sex, ethnicity, and near work activity like using the smart device were the covariates of developing refractive error on the eye. Myopia was more among those students who were using smartphone/laptops. Near activities stress on eyes of the children and might be one of the causes of developing myopia.

Keywords: Prevalence, Refractive error, School children

INTRODUCTION:

Refractive error is a problem with focusing of light accurately on the retina. The most common types of refractive errors are myopia (near-sightedness), hypermetropia (far-sightedness), astigmatism, and presbyopia.[1] The number of people affected globally with refractive errors has been estimated at one to two billion. Rates vary between regions of the world with about 80% of Asians and 25% of Europeans affected.[2]

Near-sightedness is the most common disorder.[3] It affects children and adults up to 49%while far-sightedness more commonly affects young children and the elderly.[4,5,6] According to 2013 estimates, 660 million people had uncorrected refractive errors in the world and of these 9.5 million were blind due to the refractive error. It is one of the most common causes of vision loss, the others being cataracts, macular degeneration, and vitamin A deficiency.[6]

The most common visual disorders found in school-going children are refractive errors and they are also the leading cause of blindness. It can easily be prevented if proper measures are taken timely. In

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the western part of Nepal, no estimates of refractive errors in school children are available. Considering the importance of the refractive errors the present study was undertaken in Palpa District.

METHODS

A cross-sectional school-based study was conducted among 837 students of which 368 students were from two government schools in two rural municipalities and 469 students were from two private schools in one municipality and one rural municipality of Palpa district. The multistage sampling method was used for the study and all of the children studying in the selected schools who were available at the time of the survey were included in the study. The study was conducted from December 15, 2019, to January 15, 2020.

Before conducting the study, written information detailing the purpose of the eye examination was sent to all the schools, and permission was sought. All the parents were requested to be present on the day of the examination. Those parents, who could not visit on the day of the examination, were sent a report stating their children's ocular health status. For further consultation, the parents with their children were called to the hospital.

The materials used by the team were internally illuminated E chart (provided by Nepal Netra Jyoti Sangh), torch lights, direct ophthalmoscopes (Heine Beta 200, Germany), retinoscopes (Heine Beta 200, Germany), trial set, and universal trial frames (Emami).

In this study, myopia and hypermetropia were recorded if refractive errors were more than -0.5 dioptre and more than +1 dioptre respectively. Astigmatism was recorded if the refractive error was more than 0.5 dioptre. Visual acuity in the better eye without glasses or with glasses in case of those who had been wearing the same was called presenting vision. The best-corrected vision was defined as the vision achieved by the subject in the better eye while testing for refraction. Amblyopia was diagnosed when eyesight deteriorated 6/9 or more after careful eye examination, including fundoscopy, through retarded vision and non-cyclonic refraction.[8]

All data were entered in the statistical package for social studies version 23.0 for evaluation. A Chi-square test was performed to assess the risk factors of refractive error and binary logistic regression was performed for the best fit of the model. P-value for a confidence interval of 95% was considered significant at the $p < 0.05$ level for prevalence estimates.

Institutional Review Committee (IRC) of the Lumbini Medical College & Teaching Hospital Ltd. provided ethical clearance [IRC-LMC 02-D/020] for this study.

RESULTS:

The total number of children in this study was 837. The maximum age of respondents was 18 years and the minimum age was five years. 53% were male and 47% were female. Regarding ethnicity of children, most of them were Janajati (63%) and Brahmin /Chhetri and Dalit were respectively 29% and 8%. Most of the children were from private schools (56%). The majority of the children's fathers were literate (97.6%) and 93.8% of children's mothers were literate. The prevalence of refractive error among the children was 9% (Table 1). Among them, 4% of the children had myopia, 4% had astigmatism and 1 % had hypermetropia.

Table 1. Demographic profile of refractive error (N= 837).

		Frequency (%)
Sex	Male	440 (53%)
	Female	397 (47%)
Ethnicity	Brahmin / Chhetri	246 (29%)
	Janajati	524 (63%)
	Dalit	67 (8%)
School	Private	469 (56%)
	Public	368 (44%)
Literacy of father	Literate	817 (97.6%)
	Illiterate	20 (2.4%)
Literacy of mother	Literate	785 (93.8%)
	Illiterate	52 (6.2%)
Refractive error	Yes	78(9%)
	No	759 (91%)

Sex, ethnicity, and using cellphone were the main risk factors of refractive error in school-age children (Table 2). In sex, females (about 12%) were more likely to have refractive error than males (about 7%) which was statistically significant [p=0.005(RE), 0.017(LE) <0.05, df=2]. As compared to the Brahmin/Chhetri and Janajati, Dalits were more prone to develop refractive error

Table 2. Association of refractive error with Socioeconomic Characteristics (n=837).

		Refractive Error (n/%)				p value
		Right Eye (RE)		Left Eye (LE)		(RE,LE)
		No	Yes	No	Yes	
Sex	**Male**	410(93.2)	30(6.8)	409(93)	31(7)	0.005,0.017
	Female	347(87.4)	50(12.6)	350(88.2)	47(11.8)	
Ethnicity	**Brahmin/Chhetri**	216(87.8)	30(12.2)	218(88.6)	28(11.4)	0.04, 0.042
	Janajati	484(92.4)	40(7.6)	484(92.4)	40(7.6)	
	Dalit	57(85.1)	10(14.9)	57(85.1)	10(14.9)	
School type	**Private School**	420(89.6)	49(10.4)	419(89.3)	50(10.7)	0.323,0.132
	Public School	337(91.6)	31(8.4)	340(92.4)	28(7.6)	
School performance	**Excellent**	111(91.7)	10(8.3)	111(91.7)	10(8.3)	
	Good	251(90)	28(10)	252(90.3)	27(9.7)	
	Average	288(90.3)	31(9.7)	291(91.2)	28(8.8)	
	Poor	107(90.4)	11(9.3)	105(89)	13(11)	0.955,0.870
Watching TV	**Yes**	536(90.4)	57(9.6)	539(90.9)	54(9.1)	0.934,0.741
	No	221(90.6)	23(9.4)	220(90.2)	24(9.8)	
Using smartphone/ laptop	**Yes**	216(87.4)	31(12.6)	218(88.3)	29(11.7)	0.04,0.048
	No	541(91.7)	49(8.36)	541(91.7)	49(8.36)	
Siblings	**1-2 Children**	476(90.3)	51(9.7)	478(90.7)	49(9.3)	0.878,0.978
	>2 Children	281(90.6)	29(9.4)	281(90.6)	29(9.4)	
Refractive error of parents	**None**	607(90.6)	63(9.4)	609(90.9)	61(9.1)	
	One	136(91.3)	13(23.4)	136(91.3)	13(8.7)	0.137,0.125
	Both	13(76.5)	4(23.5)	13(90.7)	4(23.5)	

(Brahmin/Chhetri= 12.4% on right and 11.6% on left eye, Janajati = 7.6%, Dalit=14.9%, p= 0.04). The prevalence of refractive error of students who were using Smartphone/laptop (about 12%) was higher than those who were not using (8.36%) which was statistically significant. On average the percent distribution of refractive error in private school (10.5%) was more than government school (8%) but was not statistically significant (p =0.323 RE, 0.132 LE > 0.05). Other factors like academic performance, school type, watching TV, siblings, and refractive error of parents were not likely to have a refractive error in children.

Table 3: Unaided visual acuity of the right and left eyes.

Visual Acuity	Right Eye N (%)	Left Eye N (%)
6/6	765 (91.4)	771 (92.1)
6/9-6/18	62 (7.4)	57 (6.8)
6/24-3/60	10 (1.2)	9 (1.1)

Among 837 students, a majority, (91.4% for the right eye and 92.1% for the left eye), of students had normal visual acuity. Ten students (1.2%) had visual acuity of 6/24 in the right eye and nine (1.1%) students in the left eye (Table 3).

The percent distribution of myopia, hypermetropia, and astigmatism of females was greater than male, which was statistically significant (p=0.029). The prevalence of myopia of male and female were respectively 41.2 % and 58.8 %.

Table 5 shows that the covariates ethnicity was highly significant for explaining the refractive error to the school children under study. As compared to the Dalit student, Brahmin /Chhetri and Janajati students were 0.783 and 0.453 times more likely to have the refractive errors.

On the other hand, the male student had about 0.505 more odds of having refractive error as compared to the female student. Next, as compared to the students who were not using a cellphone, the odd of having refractive errors were 0.682 times more among those who were using cellphones.

Table 4: Association of refractive error with sex of the children.

		Refractive Error N (%)				p value
		Myopia	Hypermetropia	Astigmatism	Plano	
Sex	Male	14(41.2)	5(45.5)	11(31.4)	410(54.2)	0.029
	Female	20(58.8)	6(54.5)	24(68.6)	347(45.8)	

The p-value for calculated chi-square is seen as less than 0.05. Hence, overall, the model coefficients were significant at a 5% level of significance.

The Cox and Snell R square and Nagelkerke R square were obtained as 0.021 and 0.044 respectively. The first one indicates that the 2.1% of the variation in refractive error to the student under study was explained by the covariates used in the fitted model and the second one indicates the 4.4% of the variation in refractive error to the student was explained by the covariates.

DISCUSSION:

In our study children aged 5–18 years at different public and private schools in Palpa district were included in the study. Four Schools among which two private and two government schools were selected by multistage sampling method. The fieldwork was carried out between December 2019 and January 2020. A total of 837 students were examined.

In our study, 9% of children had a refractive error of ± 0.5 or worse in one or both eyes and needed glasses. Among refractive errors, myopia and astigmatism were the most common (4.1% and 4.2% respectively) followed by hypermetropia (1.3%); this was slightly higher compared with other studies carried out in another district as Jhapa 8.6% (3.9% myopia, 1.7% hypermetropia, and 3% astigmatism) and Pokhara 6.43% (4.05% myopia, 1.24% hypermetropia, and 1.14% astigmatism).[7,9] The prevalence of refractive error in Kathmandu is 11.6% which is greater than our study.[10] However, Pradhan N reported a prevalence of 7.0% in which myopia was the most common refractive error 44 (61.9%) followed by astigmatism 16 (24.1%) and hypermetropia (14%) among the children with refractive errors.[1]

However, the percentage distribution of refractive errors in our present study was higher than the refractive errors recorded by Naidoo et al., (4.7%) in South Africa, and Schimiti et al., (4.55%) in Brazil.[11,12] Assefa WY reported refractive errors in either eye were present in 174 (9.4%) children. The myopia of children was detected in 55 (31.6%) in the right and left eyes followed by far-sightedness in 46 (26.4%) and 39 (22.4%) in the right and left eyes respectively.[3] The proportion of refractive errors found in India, Chile and Zaire was 25.32%, 17.05%, and 16% respectively.[13,14,15] These researches suggested that the proportion of refractive errors was much higher than our results. The wide variations of percentage distribution of refractive errors observed by different authors were naturally likely to be due to: sample size, different geographical situation, ethnic variation, nutritional status and different criteria adopted by different authors. It seems that refractive errors especially in growing children were one of the major health problems in both developed and developing countries.

Table 5: Model summary of associative factors of refractive error.

Covariates	Coef.	S.E.	Wald	df	P-value	Odds Ratio	Model Summary	Cox & Snell R square	Nagelkerke R Square
Sex Male (Female)	-0.684	0.245	7.787	1	0.005	0.505			
Ethnicity			6.848	2	0.033				
B/C(Dalit)	-0.245	0.398	0.377	1	0.539	0.783	Chi-square = 17.47	0.021	0.44
Janajati (Dalit)	-0.792	0.385	4.242	1	0.039	0.453			
Use of Cell Phones No (Yes)	-0.383	0.247	2.411	1	0.120	0.682	df = 4		
Constant	- 1.146	0.390	8.848	1	0.003	0.318	P - value = 0.002		

Variable(s) entered on step 1: Sex, Ethnicity, Cell phone, B/C=Brahmin/ Chhetri

In our present study, the percentage of refractive errors in the girls was found more (about 12%) than in the girl's counterpart (about 7%) which is statistically significant ($p<0.05$). Pradhan N reports the refractive error of female students (7.86%) was affected more than males (6.22%).[1] However, some studies in Nepal and Chile did not find a gender difference in refractive errors.[13,16]

In our study, the percent distribution of refractive error in Dalit students was found more (14.9%) followed by Brahmin/Chhetri, and Janajati (7.6%) which is statistically significant [p=0.04(RE), 0.042(LE)]. In Pokhara, the percent distribution of refractive error of Dalit students was comparatively less than Brahmin/Chhetri and Janajati.[7] The study compared the refractive error in different ethnic groups (African American, Asian, Hispanic, and white) in grades 1 to 8 (age, 5-17 years) and found that refractive error was statistically significant with ethnicity.[17] In the context of Nepal, most of the Dalit community was poor, regarding poor family they could not eat nutritious food, and regular checkup which may be the cause of the refractive error.

The percent distribution of refractive error in our study in private school children {10.4% (RE),10.7% (LE)} was comparatively higher than public school (8.4% RE, 7.6% LE) which is not statistically significant ($p>0.05$). But Niroula DR reported the refractive errors were found more in private school children (9.29%) than Government school children (4.23%), which is statistically significant ($p<0.05$).[7] In Jhapa, refractive error was significantly high in private school (10.3%) than government schools(6.9%) ($\chi^2 = 6.7$, $df = 1$, $p < 0.01$). [9] A study conducted in Gondar town, northwest Ethiopia reported private school children were 2.88 times at risk of developing myopia when compared to those who attended government schools,[18] and this finding is similar to a study conducted in China. [19]

In our study the prevalence of refractive error using smart phone/laptop (about 12%) was higher than those who were not using (8.36%) which is statistically significant. As compared to the children who had not used those are 0.6 times likely to have refractive error than using Smartphone/ laptop. Ichhpujani P reported slightly less than half (278, 48.3%) of students used digital devices every day, 24% (138) used them 3–4 times a week, 15.1% (87) used them 1–2 times a week, and 12.7% (73) used these digital devices 5–6 times a week. With increased age, there was a statistically significant association with increased digital device use in a week.[20]

This study has a few limitations. This was a school-based cross-sectional study. This study does not consider the environmental and clinical factors which are major contributors to refractive errors. Non-cycloplegic refraction was done instead of cycloplegic which may arise some correction on refractive error. The information of the parent's refractive error was taken by either use of glass or not, so this information may not be adequate.

CONCLUSION:

The prevalence of refractive error was 9%. Myopia, hypermetropia, and astigmatism of females were greater than males, which was statistically significant. Interestingly, in the present study, the refractive errors were found significantly higher in Dalit children than Brahmin/Chhetri and Janajati. The developing of myopia in student who were using Smartphone/laptop was significantly higher than those who were not using because near activities cause stress on eyes of the children and might be one of the causes of developing myopia. Only sex, ethnicity, and near work activity like using the smart device were the covariates of developing refractive error on the eye but clinical characteristics for developing refractive error could not be measured in this study.

Conflict of Interest: The authors declare that no competing interests exist.

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