Ocular morbidity prevalence among school children in Shimla, Himachal, North India

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Background: Data on eye diseases among school children is not readily available. Considering the fact that one-third of India's blind lose their eyesight before the age of 20 years and many of them are under five when they become blind, early detection and treatment of ocular morbidity among children is important.

Aim: To estimate the prevalence of ocular morbidity among school children of age 6-16 years.

Settings: Government and private coeducational schools in urban area of Shimla.

Design: Cross-sectional

Materials and Methods: Government and private coeducational schools selected by stratified random sampling. About 1561 school children, studying in elementary through secondary class in these schools were examined from August 2001 to January 2002 in Shimla. A doctor did visual acuity and detailed ophthalmic examination.

Statistical analysis: The Chi-square test was used to test differences in proportions. Differences were considered to be statistically significant at the 5% level.

Results: Prevalence of ocular morbidity was 31.6% (CI=29.9-32.1%), refractive errors 22% (CI=21.1-22.8%), squint 2.5% (CI=2.4-2.6%), color blindness 2.3% (CI=2.2-2.4%), vitamin A deficiency 1.8 % (CI=1.7-1.9%), conjunctivitis 0.8% (CI=0.79-0.81%). Overall prevalence of ocular morbidity in government and private schools did not show any statistical significant difference. Prevalence of conjunctivitis was significantly (P<0.5) more in government schools.

Conclusion: A high prevalence of ocular morbidity among high-school children was observed. Refractive errors were the most common ocular disorders.

Key words: Ocular disorders, ocular morbidity, prevalence, refractive errors, school children

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Visual impairment is a worldwide problem that has a significant socioeconomic impact. Childhood blindness is a priority area because of the number of years of blindness that ensues. Data on the prevalence and causes of blindness and severe visual impairment in children are needed for planning and evaluating preventive and curative services for children, including planning special education and low vision services. The available data suggest that there may be a tenfold difference in prevalence between the wealthiest countries of the world and the poorest, ranging from as low as 0.1/1000 children aged 0-15 years in the wealthiest countries to 1.1/1000 children in the poorest.[1] It is estimated that the cumulative number of blind-person-years worldwide due to childhood blindness ranks second only after the cumulative number of blind-person-years due to cataract blindness.[2] Considering the fact that 30% of India's blind lose their eyesight before the age of 20 years and many of them are under five when they become blind, the importance of early detection and treatment of ocular disease and visual impairment among young children is obvious.[3]

Children do not complain of defective vision, and may not even be aware of their problem. They adjust to the poor eyesight by sitting near the blackboard, holding the books closer to their eyes, squeezing the eyes and even avoiding work requiring visual concentration. This warrants early detection and treatment to prevent permanent disability. Effective methods of vision screening in school children are useful in detecting correctable causes of decreased vision, especially refractive errors and in minimizing long-term visual disability.[3]

Seventy-five per cent of all school age children are school-going children. The dropouts mostly belong to families with

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low socioeconomic status, minimal family education and economic necessity for wage earning to support the family.[4,5] Children in the school-going age group (6-16 years) represent 25% of the population in the developing countries. They offer significantly representative material for these studies as they fall best in the preventable blindness age group, are a controlled population i.e., they belong to a certain age group and are easily accessible and schools are the best forum for imparting health education to the children. Schools are also one of the best centers for effectively implementing the comprehensive eye healthcare program.[3] Hence, this study was conducted with the objective of estimating the prevalence of ocular morbidity among school children.

Materials and Methods

The study was conducted in the urban area of Shimla, the capital of Himachal Pradesh, North India among school-going children of class one to tenth (age 6-16 years) from selected schools from August 2001 to January 2002. Shimla is situated in North West Himalayas. It has a total population of 721,745 with 23% (166,833) in the urban area and 77% (554,914) in the rural area. Economy is mainly based on agriculture. Municipal Corporation runs the administration in the urban area. Major religion is Hindu, languages spoken are Hindi and Pahari, major culture and traditions are Pahari.[6]

Under the municipal corporation of Shimla, there were 120 schools. Out of which 104 (87%) were coeducational and 16 (13%) single sex systems (seven only boys and nine only girls) as per data available at district education cell in 2001. Total school children from class one to tenth were 61,600 (52,000 in coeducational schools and 9600 in single sex system schools). Since coeducational schools represented 84.4% of student population and had equal representation from both sexes, only these were included in the study. There were 77 government (56 primary, four secondary, 17 higher secondary,) and 27 private coeducational schools (24 higher secondary, three primary). The formula used for calculating sample size was $N= t^2 PQ/d^2$, where t=1.96 at 95% confidence level; d=precision- 2.5%; P= reported prevalence 30% (0.30); Q=1-P = 70% (0.70). Sample size was calculated to be 1344 school children. By stratified random sampling, seven government (five primary, two higher secondary) and two private coeducational schools (both higher secondary) were selected randomly with proportionate representation from each category of schools.

Children studying in single sex system schools and coeducational schools did not differ much in terms of culture, religion, ethnic values and socioeconomic status. However, the difference existed in private and government schools in terms of more fees per month and better infrastructure like bigger classrooms, better chairs and tables for the students, open space to play for students in private schools. Hence, generally children from upper and high middle socioeconomic status got admission in these schools. In government schools, school fees were minimal and students from all the socioeconomic strata got admissions.

The principals of the selected schools were informed about the study and permission for the visit to the selected schools was sought personally. The principals of the selected schools informed the parents of the students regarding the study and permission was taken through school diaries.

The data collection instrument was a pretested structured questionnaire. It was pretested in a randomly selected coeducational school which was not included in the study. Queries from children were asked in Hindi language, while information was filled in English language by the principal investigator, a postgraduate in community medicine. She had been trained in these procedures by a qualified ophthalmologist during her MD thesis work. Visual acuity (unaided) was assessed by using Snellen's chart, color blindness was checked by using Ishihara's chart, axis deviation was assessed by cover/uncover test and torch examination of the eye was done.

The first part of the questionnaire dealt with information regarding the child like age, sex, residential address, class in which studying and chief complaints related to eyes. Second part of the questionnaire included detailed examination of eye for diagnosing ocular morbidity and recording of vitamin A deficiency signs and their ocular manifestations. The cutoff of uncorrected visual acuity for defining ocular morbidity due to refractive error in this study, was taken as a visual acuity of <20/30 Snellen in the worst eye. Visual acuity worse than 20/400 was recorded as count fingers (CF at a certain number of feet), hand motion (HM at a certain number of feet), light perception (LP), or no light perception (NLP). The conversion of Snellen acuity to count fingers acuity was then obtained.[7] The WHO clinical staging for trachoma and xeropthalmia was used.[8,9] Vitamin A deficiency was diagnosed if there was history of night blindness, or on examination there were signs of conjunctival xerosis, Bitot's spots, corneal xerosis or keratomalacia. Vitamin C deficiency was diagnosed if there was history of bleeding gums and on examination there were conjunctival hemorrhages. Congenital disorders were also looked for like heterochromia iridium, ptosis, irregular pupil, erected upper lacrimal puncta, congenital cataract.

Examinations were performed in the respective school compounds. Due consideration was given to the length of the room, so that it should be longer than 20 feet and also to lighting, while selecting it. Similar method of examination was followed in government and private schools. All the children present in the class at the time of visit were examined in one sitting. Maximum efforts were put to include all the students of the class. Absentees were tracked for up to five consecutive days.

After checking the questionnaire for errors the data was entered into a computer database and analyzed using Epi info 2000 statistical software. The Chi-square test was used to test differences in proportions. Differences were considered to be statistically significant at the 5% level.

Results

A total of 1601 (814 in government and 787 in private schools) children of age 6-16 years were enrolled from elementary through tenth class in the selected schools. Out of these, 40 children could not be contacted because they were absent for more than five days of follow-up. Hence, a total of 1561 (794 in government and 767 in private schools) school children were examined for ocular morbidity. Response rate was 97.5% in both types of schools. Males (52.08%) and females (47.91%) had almost equal representation in both types of schools [Table 1].

Overall prevalence of ocular morbidity among school children of age 6-16 years was 31.6% [Table 2]. Refractive errors (22.0%) constitute the major cause of ocular morbidity followed by squint (2.5%), color blindness (2.3%), vitamin A deficiency (1.8%) and conjunctivitis (0.8%). Similar prevalence of ocular morbidity among government (30.7%) and private schools (32.7%) was observed. Prevalence of refractive errors in government schools (21.5%) and private schools (22.6%) was also similar. However, the prevalence of conjunctivitis was significantly more (1.5%) among government school children as compared to children (0.1%) in private schools (P<0.05). For the rest of the ocular morbidities prevalence did not vary significantly with type of school.

Table 1: Gender breakdown of students in selected schools

School	Male n (%)	Female n (%)	Total n
Government Schools			
Primary School, Lakkar Bazaar	21(55.2)	17(44.7)	38
Primary School, Bharari	22(56.4)	17(43.5)	39
Primary School, Sanjauli	22(57.8)	16(42.1)	38
Primary School, Boileauganj	72(61)	46(39)	118
Primary School, Chakkar	34(51.5)	32(48.5)	66
Higher Secondary School, Jakhoo	67(54)	57(46)	124
Higher Secondary School, Summer hill	201(54.2)	170(45.8)	371
Total	439(55.2)	355(44.8)	794
Private schools*			
Himalayan Public School, Upper Kaithu	180 (49.3)	185(50.6)	365
St. Thomas School, Lower Kaithu	194(48.2)	208(51)	402
Total	374(48.8)	393(51.2)	767

*Up to higher school level

There was no sex preponderance for overall prevalence of ocular morbidity [Table 3]. However, prevalence of color blindness was significantly (P<0.05) more among males (3.9%) as compared to females (0.53%). Females (39.5%) presented with significantly more complaints related to eyes like defective vision, watering of eyes, pain in and around eyes, redness of eyes as compared to males (18.9%). Nearly half (41.9%) of the males who had been diagnosed as suffering from one or other ocular disorder, were asymptomatic. Self-reported ocular symptoms by females were more sensitive (100%) and less specific (87%) as compared to males (sensitivity 58%, specificity 97%).

Overall prevalence of ocular morbidity decreased significantly with age in government schools [Table 4]. However, it increased up to 10-12 years then declined significantly in private schools also (P<0.05). Prevalence of squint decreased significantly after 10 years of age in both the schools (P<0.05). Prevalence of refractive errors increased significantly after 10 years of age in private schools.

Discussion

The current work, conducted in Shimla, confirms the high prevalence of overall ocular morbidity and refractive errors among high school students in urban North Indian area and highlights the urgent need to implement at school level health facility-based, cost-effective strategies, and appropriate eye care programs targeting school children to reduce the burden of visual impairment among the younger population.

Population-based data concerning prevalence of ocular morbidity among children are not readily available for India. For the available studies results are not comparable because of different methodologies/criteria used in those studies. The prevalence of ocular morbidity of 31.6% among school children of age 6-16 years in this study is similar to a study conducted in Delhi, where prevalence was reported to be 34.04% in the 5-14 years age group.[10] However, higher prevalence of ocular morbidity has been reported from neighboring states like Haryana (58.8% in 4-18 years) and Rajasthan (71.7% in 4-16

Table 2: Prevalence of ocular morbidity in government and private schools in Shimla

Ocular Morbidity	School		Total n=1561 %	Confidence interval at 95%	*P* value
	Government n=794 %	Private n=767 %			
Refractive Errors	21.5	22.6	22.0	21.14-22.85	0.6
Squint	1.8	3.2	2.5	2.4-2.6	0.08
Color Blindness	1.8	2.7	2.3	2.2-2.4	0.3
Partial	1.6	2.7	2.1	2.01-2.18	
Total	0.25	0	0.1	0.095-0.104	
Vitamin A Deficiency	1.1	2.4	1.8	1.7-1.9	0.06
Congenital Disorders	1.13	0.5	0.8	0.79-0.81	0.3
Conjunctivitis	1.5	0.1	0.8	0.79-0.81	0.007
Vitamin C Deficiency	0.7	0.2	0.5	0.48-0.51	0.3
Spring Catarrh	0.5	0.3	0.4	0.43-0.46	1.0
Seborrhoeic Dermatitis	0.1	0.1	0.1	0.11-0.12	0.5
Stye	0	0.1	0.06	0.057-0.062	0.9
Total	32.5	30.6	31.6	29.9-32.1	0.4

Table 3: Sex-wise distribution of ocular morbidity

Ocular morbidity	Sex		Total	*P* value
	Male n=813 %	Female n=748 %	n=1561 %	
Refractive Errors	22.5	21.5	22.0	0.63
Squint	1.9	3.2	2.5	0.12
Color Blindness	3.9	0.5	2.3	0.00002
Partial	3.7	0.5	2.1	
Total	0.2	0	0.1	
Vitamin A Deficiency	2.1	1.5	1.8	0.85
Congenital Disorders	0.5	1.2	0.8	1.6
Conjunctivitis	0.9	0.8	0.8	0.9
Vitamin C Deficiency	0.24	0.8	0.5	0.24
Spring Catarrh	0.2	0.6	0.5	0.38
Seborrhoeic Dermatitis	0.2	0	0.1	0.42
Stye	0	0.1	0.06	0.96
Total	32.5	30.6	31.6	0.3

years) and also from Hyderabad in South India (43.5% in 3-16 years).[11-13] It was because of the higher prevalence of trachoma and conjunctivitis found in these two northern states and of refractive errors found in South India. Moreover, the range of age groups covered in the above mentioned studies was also more as compared to the present study. Lower prevalence (15%) of ocular morbidity has been reported from Kolkata, West India among school children of 5-13 years, because of lower prevalence of refractive errors (2%) and smaller age group covered in that study.[14] Review of international studies revealed lower prevalence of 15.6% of ocular morbidity in children aged 7-19 years in rural area of Tanzania, Africa.[15] International differences in prevalence may also be explained by racial and ethnic variations, partly due to different lifestyles and living conditions in addition to different methodologies used.

Higher prevalence of conjunctivitis in children studying in government schools as compared to private schools as observed in this study could be because many of the students in government schools belong to lower socioeconomic status and are more likely to have poor personal hygiene.[16]

Poor vision in childhood affects performance in school or at work and has a negative influence on the future life of a child. Moreover, planning of the youth's career is very much dependent on visual acuity, especially in jobs for the navy, military, railways and aviation. Refractive errors are the most common reasons of the outpatient visit to an ophthalmic surgeon or an ophthalmic assistant. The overall incidence has been reported to vary between 21% and 25% of patients attending eye outpatient departments in India.[17] Similar prevalence of refractive errors has been observed among children of 12-17 years in Ahmedabad city.[18] From South India, higher (32%) prevalence rate of refractive errors among school children of age 3-18 years as compared to the present study was observed, because of higher case detection rate in that study by an optometrist.[13] However, low prevalence of refractive errors of 2% has been reported from Eastern India by Datta *et al*., among primary school children of 5-13 years, which could not be explained.[14] Internationally, lower prevalence of refractive errors (2.7-5.8%) has been reported among children of age 5-15 years from Africa, Finland, Chile and Nepal as compared to the present study.[15,19-21] These differences may be explained by the different diagnostic criteria used by different authors, racial or ethnic variations in the prevalence of refractive errors, different lifestyles or living conditions (e.g. reading, watching TV, or using computer/ visual display units, nutrition) or medical care (e.g. unnecessary or overcorrection of refractive errors which may worsen the refractive error by inhibiting natural "emmetropisation").

Table 4: Age-wise ocular morbidity in government and private schools in Shimla

Diseases	Schools											
	Government						Private					
	6-8 n=150 %	8-10 n=149 %	10-12 n=171 %	12-14 n=164 %	14-16 n=160 %	*P*	6-8 n=141 %	8-10 n=152 %	10-12 n=128 %	12-14 n=192 %	14-16 n=154 %	*P*
Refractive Errors	26.6	26.8	21.0	17.0	16.8	> 0.05	12.7	17.7	35.9	22.9	24.6	0.005
Squint	2.0	4.6	0	3.0	0	0.02	4.2	3.2	0.7	5.7	1.3	0.002
Color Blindness	2.0	4.0	1.0	0.6	1.8	>.05	2.1	4.6	1.6	2.1	3.2	> 0.05
Vitamin A Deficiency	1.3	0.6	1.7	0.6	1.2	> 0.5	2.1	1.9	4.6	2.1	1.9	> 0.05
Congenital Disorders	3.3	2.0	0	0.6	0	> 0.05	0	0	1.5	0	1.3	> 0.05
Conjunctivitis	0.6	2.6	1.0	1.2	1.8	> 0.05	0	0.6	0	0	0	> 0.05
Vitamin C deficiency	2.0	0	1.0	1.6	0	>0.05	0	1.3	0	0	0	> 0.05
Spring Catarrh	0.6	0.6	0	0.6	0.6	>.05	0	0.6	0	0	1.3	> 0.05
Seborrhoeic dematitis	0.6	0	0	0	0	> 0.05	0	0.6	0	0	0.1	> 0.05
Stye	0	0	0	0	0	-	0	0	0	0.1	0	> 0.05
Total	40.6	41.6	26.3	24.3	22.5	0.02	20.5	30.9	44.5	33.3	33.1	0.01

Similar prevalence of color blindness has been observed in an earlier study conducted in this part of the country.[22] Comparable results (2.9% in 4-16 years) have also been reported from Rajasthan.[12] However, lower prevalence of color vision defects (0.11%) has been reported by Pratap *et al*., from North India.[23] A different study population (children who attended eye care centre in the last 18 months) in their study may explain this. Children are less likely to attend eye care centres for colour blindness.

Prevalence of squint as reported by Pratap *et al*., of 2.8% of primary squint and that of paralytic squint as 0.42%, is comparable with the results of the present study.[23] However, higher (7.4% in 5-15 years) and lower (0.2-0.6% in 4-18 years) prevalence of squint has been reported from Haryana, Rajasthan, West Bengal and Delhi.[11,12,14,24] Studies done abroad also revealed lower prevalence of squint (0.5%) by Wedner *et al*., among children of 7-19 years in Tanzania, Africa.[15]

Vitamin A deficiency up to an extent of 5.4-9% in 4 to 16 years has been reported from Rajasthan and Kolkata respectively as compared to 1.8% in the present study.[12,14] This can be explained by lower socioeconomic status associated with unhealthy dietary pattern of children in those studies. Prevalence of vitamin A deficiency decreased with age in the present study, which is comparable to the Desai *et al*., study.[12] The prevalence of night blindness (0.41%) in the present study is comparable to results of earlier studies showing prevalence to vary from 0.29-0.3% in Haryana and North India.[11,23] Internationally, Wedner *et al*., reported the prevalence of night blindness as 5.3% and bitot's spots as 0.6% among school children of age 7-19 years in Tanzania.[15] Since their study was done in the rural area, where children belonged to low socioeconomic status and had poor nutritional status, prevalence of vitamin A deficiency was high.

Higher (3-17.5%) prevalence of conjunctivitis has been reported in other parts of India.[11,12,14,23] However, Robinson *et al*., reported 1.5% prevalence of conjunctivitis among children of 1-17 years in North America, which is similar to this study.[25] Variation in the prevalence of conjunctivitis can be explained by difference in socioeconomic status, personal hygiene of children and seasonal variations of occurrence of conjunctivitis. Low prevalence of congenital disorders was found to be the same as it has been observed in other studies from India.[11,12]

Marginal difference in the prevalence of ocular diseases among males and females in the present study is comparable to results of the study by Sehgal *et al*., in Delhi (males 46.1% and females 48.3%).[10] However, Khurana *et al*., reported higher prevalence in females (73.5%) as compared to males (49.4%) in Haryana.[11] In their study, prevalence of infectious diseases like trachoma, conjunctivitis and blepharitis was high among females because of increased use of common ocular cosmetic material. Prevalence of vitamin A deficiency was found to be more among males as compared to females in this study contrary to the results of other studies.[12,14] This difference was more appreciable with prevalence of night blindness. However, being subjective, the symptom of night blindness cannot be relied upon completely. Color blindness is a sex-linked disease hence it was found to be significantly higher amongst males in this study.

In almost all studies conducted in India, the prevalence of ocular morbidity decreased with age, the results of our study also confirmed this finding in an urban North Indian hilly area.[11-14] The decrease in prevalence of ocular defects with increasing age of children may be due to age dependence of eyeball and improved ophthalmic hygiene as a result of health education. Higher prevalence of refractive errors in the younger (6-10 years) age group could be because of high prevalence of age-related hypermetropia in young children as is also observed from other studies in North India.[12,17,18]

The results of the study strongly suggest that screening of school children for ocular problems should be done at regular intervals and it should be one of the prime components of the School Health Program. For this, school teachers should be oriented and trained in identifying common eye problems among school children so that these children can be referred for prompt treatment. They should also impart awareness regarding ocular hygiene among school children. In this manner the incidence of preventable causes of blindness among school children will be minimized. Identification of color vision defects with concurrent vocational counseling should also be done at the earliest in school children to save the child from frustration later on and help him to choose a suitable vocation.

The limitation of this study could be overlooking seasonal variation in the ocular morbidity as the study period mainly involved winter months.

It was concluded that high prevalence of ocular morbidity among high school children was observed in urban Shimla. Refractive errors were the most common ocular disorders. School health programs should focus on the ocular health of children. Health education activities should be intensified in schools and also in the community regarding signs and symptoms of ocular disorders. Finally, the aim of all blindness control programs should be to propagate awareness in the masses of eye care and to teach the essentials of ocular hygiene and eye healthcare.

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References

1. Gilbert CE, Anderton L, Dandona L, Foster A. Prevalence of visual impairment in children: A review of available data. Ophthalmic Epidemiol 1999;6:73-82.
2. Foster A. Worldwide blindness, increasing but avoidable. Semin Ophthalmol 1993;8:166-70.
3. Vision screening in school children. Training module. Danish Assistance to the National Programme for Control of Blindness. New Delhi, India: 1.
4. Bhagyalakshmi J. Presenting Educational Science: What next?" Yojana 2001;45:48-9.
5. Drop out in Himachal Pradesh. Avilable from http://www.indiastat.com/india/showtable.asp?secid=363047andptid=6373andlevel=4. [last accessed on 2008 Apr 13].
6. Shimla fact file. Available from: http://hpshimla.nic.in/sml_fact.htm. [last accessed on 2007 May 10].
7. Watt WS. How visual acuity is measured. Available from http://www.mdsupport.org/library/acuity.html. [last accessed on 2007 Jul 9].

8. Thylefors B, Dawson CR, Jones BR, West SK, Taylor HR. A simple system for assessment of trachoma and its complications. Bull World Health Organ 1987;65:477-85.
9. Sommer A. Field guide to the detection and control of xerophthalmia. 2nd ed. Geneva: WHO; 1982.
10. Sehgal K, Kant L, Jain BK, Lal K. Prevalence of Eye diseases in a semi urban area. Indian J Public Health 1984;28:189-93.
11. Khurana AK, Sikka KL, Parmar IPS, Aggarwal SK. Ocular morbidity among school children in Rohtak city. Indian J Public Health 1984;28:217-20.
12. Desai S, Desai R, Desai NC, Lohiya S, Bhargava G, Kumar K. School eye health appraisal. Indian J Ophthalmol 1989;37:173-5.
13. Kalikivayi V, Naduvilath TJ, Bansal AK, Dandona L. Visual impairment in school children in Southern India. Indian J Ophthalmol 1997;45:129-34.
14. Datta A, Choudhury N, Kundu K. An epidemiological study of ocular condition among school children of Calcutta Corporation. Indian J Ophthalmol 1983;31:505-10.
15. Wedner SH, Ross DA, Balira R, Kaji L, Foster A. Prevalence of eye diseases in primary school children in a rural area of Tanzania. Br J Ophthalmol 2000;84:1291-7.
16. Conjuctivitis. Community Eye Health 1999;12:20. Available from http://www.jceh.co.uk/download/ceh_12_30_020.pdf. [last accessed on 2008 Aug 7] .
17. Goswami A, Ahmed E, Shaha PL, Roy IS. An epidemiological pattern of cases of refractive errors. J Indian Med Assoc 1978;72:227-8.
18. Sethi S, Kartha GP. Prevalence of refractive errors in school children (12-17 years) of Ahmedabad City. Indian J Community Med 2000;25:181-3.
19. Laatikainen L, Erkkila H. Refractive errors and other ocular findings in school children. Acta Ophthalmol 1980;58:129-36.
20. Maul E, Barroso S, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: Results from La Florida, Chile. Am J Ophthalmol 2000;129:445-54.
21. Negrel AD, Maul E, Pokharel GP, Zhao J, Ellwein LB. Refractive error study in children: Sampling and measurement methods for a multi-country survey. Am J Ophthalmol 2000;129: 421-6.
22. Sharma V. Prevalence and pattern of colour vision defects in school going children by ishiara plates: 1997. (Unpublished source).
23. Pratap VB, Lal HB. Pattern of paediatric ocular problems in North India. Indian J Ophthalmol 1989;37:171-2.
24. Chaturvedi S, Aggarwal OP. Pattern and distribution of ocular morbidity in primary school children of rural Delhi. Asia Pac J Public Health 1999;11:30-3.
25. Robinson B, Acron CJ, Millar CC, Lyle WM. The prevalence of selected ocular diseases and conditions. Optom Vis Sci 1997;74;79-91.

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