Prevalence of ocular morbidity in school going children in West Uttar Pradesh

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Aim of the Study: This study aims to evaluate the prevalence and to make a comparison between the ocular morbidity pattern in school going children of urban and rural areas of West Uttar Pradesh. **Materials and Methods:** A school-based cross-sectional study design was adopted to examine children aged 5–15 years in randomly selected urban and rural schools of West Uttar Pradesh from June 2012 to August 2014. An optometrist did the vision and refraction, and a detailed ophthalmic examination was done by an ophthalmologist. Children needing further assessment were referred to a higher center. Interpretation and analysis of the data were done using Epi Info Software and *t*-test. **Results:** A total of 4838 students (2271 males and 2567 females) were screened. The prevalence of ocular morbidity was 29.35% (28.65% urban, 30.05% rural). Refractive error (17.36%) was the major cause of ocular morbidity followed by convergence insufficiency (2.79%), blepharitis (2.11%), Vitamin A deficiency (2.09%), allergic conjunctivitis (1.92%), bacterial conjunctivitis (0.95%), amblyopia (0.41%), stye (0.31%) and squint (0.27%). There was an increase in ocular morbidity with age, especially in refractive error and convergence insufficiency. On comparing urban and rural schools, Vitamin A deficiency showed a significantly higher prevalence ($P < 0.05\%$) in the rural (3.03%) as compared to the urban sector (1.15%). The prevalence of visual impairment was 4.9/1000 children, and prevalence of blindness was 0.62/1000 children. **Conclusion:** This study was the first of its kind in West Uttar Pradesh, reporting a considerable high prevalence (29.35%) of pediatric ocular morbidity, which was more in rural as compared to the urban sector. Since most of this morbidity is either preventable or treatable, school screening forms an effective method to reduce this load.

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The child of today is the adult citizen of tomorrow and leader of the community and country as a whole in different spheres of life. It worries us more learning that in the world today a child goes blind every minute. Over 90% of blind children receive no schooling and will be unable to realize their full potential. Thus, blindness in children accounts for one-third of the economic cost of blindness although it represents <4% of the overall magnitude.[1] Childhood blindness is the second largest cause of blind-person years, following cataract. Globally, approximately 70 million blind person years are caused by childhood blindness. There are an estimated 1.4 million blind children worldwide, 73% of whom live in low-income countries.[2] An additional 7 million suffer from low vision, and another 10 million children have a correctable refractive error causing visual impairment (refractive bilateral visual acuity [VA] of <6/18).[3] India has an estimated 320,000 blind children, more than any other country in the world.[4] Estimated National Prevalence of Childhood Blindness/Low Vision is 0.80/1000 in India.[5] Most of the available studies demonstrate that corneal and lenticular conditions are the predominant causes of blindness, whereas among children outside blind schools, refractive errors are important causes of visual impairment and blindness.[3] In children of age range 5–15 years, the visual impairment is 6.4%, with refractive errors as the major cause.[6]

The control of blindness in children is considered a high priority within the "WHO's Vision 2020 - The Right to Sight Programme."[7] Many conditions associated with blindness lead to childhood mortality; hence, control of blindness in children is closely linked to child survival.[8]

Population-based studies have estimated the prevalence of blindness as 1.25/1000 children in rural[9] and 0.53/1000 children in urban areas[10] in the age group of 5–15 years.

The available data suggests that there may be a tenfold difference in the prevalence 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.[11] Considering the fact that 30% of India's blind lose their sight before the age of 20 years, the importance of early detection and treatment of ocular morbidity and visual impairment in young children is obvious.[12] Inadequate infrastructure, funds, political will, national commitment and appropriate research are the barriers to eye care and blindness control. School eye screening is a cost-effective method that plays a vital role to overcome such barriers, and helps in early detection, prevention and treatment of childhood blindness/visual impairment. Nonetheless, the

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incidence of childhood blindness is very difficult to ascertain, and there is not much reliable data from developing countries. Likewise, not much data is available in the northern region of India, especially in rural sector. Keeping this in mind, our study was designed to estimate the prevalence of various ophthalmic diseases, and to derive a comprehensive comparative data between the urban and rural sectors among primary school children in West Uttar Pradesh, with the aim of prevention of blindness by early detection and treatment of ocular disorders. Let no child miss the beauty, pleasure and opportunities that this world has for them.

Materials and Methods

A cross-sectional study design was adopted to screen school children from randomly selected schools in urban and rural areas of West Uttar Pradesh from June 2012 to August 2014. All children aged 5–15 years that were present in the school on the day of examination were included in the study. West Uttar Pradesh includes 26 districts in six divisions. In the first stage, six districts within a 100 km radius of Meerut city were randomly selected. These were Meerut, Baghpat, Ghaziabad, Hapur, Muzaffarnagar and Bijnor. Out of these, seven urban and eight rural schools were then randomly selected. In the second stage, school children aged 5–15 years were screened. They were then divided into 4 age groups for analysis. These were Group 1 (5–7 years), Group 2 (8–10 years), Group 3 (11–13 years) and Group 4 (14–15 years).

Before examination, permission and informed consent duly signed both in Hindi and English were taken from the principal of the school, and a date for screening was fixed. Examination was done in the respective school campuses in clean, quiet and well-lit rooms. Only children present on the day of examination were screened. History taking was done from the children as well as the teachers. VA was measured using the Snellen's VA chart at 6 m. Children with VA <6/9 underwent a pinhole vision to differentiate refractive errors from pathological conditions. Refractive error was diagnosed when a VA worse than 6/9 improved on pinhole test. Undilated retinoscopy and subjective correction for children with uncorrected VA <6/6 were done. Cycloplegic refraction and post-mydriatic (PMT) were not done in the school. Ocular movements were checked, and convergence insufficiency testing was done. Anterior segment examination including lids, lacrimal sac, conjunctiva, cornea, anterior chamber, pupil, iris and lens was done using a torch light, and a handheld slit-lamp. Visual axis alignment was checked using cover-uncover, alternate cover and Hirschberg tests. Undilated fundus examination was done for every child using the small pupil aperture of a direct or an indirect ophthalmoscope depending on the examiner's preference. Children not improving to 6/6 with a pinhole underwent a dilated fundus examination after tropicamide drops instillation. A pro forma was used for documentation. Children needing further assessment and management were referred to a higher center. VA assessment, cycloplegic refraction with cyclopentolate-tropicamide-cyclopentolate, PMT, orthoptics, a detailed anterior segment and posterior segment examination, relevant investigations, and the necessary management was done for the children who reported in the clinic. Interpretation and analysis of the data were done using Epi Info Software (developed by Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, USA) and *t*-test was used.

Results

A total of 4838 (urban schools - 2429; rural schools - 2409) children consisting of 2271 (47%) males and 2567 (53%) females in the age group 5–15 years were screened [Fig. 1 and Table 1]. The children were divided into four age groups. These were, Group 1 (5–7 years) with 435 (45%) males and 541 (55%) females, Group 2 (8–10 years) with 659 (49%) males and 697 (51%) females, Group 3 (11–13 years) with 685 (46%) males and 806 (54%) females, and Group 4 (14–15 years) with 492 (48%) males and 523 (52%) females. Similarly, children were divided into four age groups, in the urban school category and rural school category. Overall, the proportion of females was more as compared to males [Fig. 2].

The overall prevalence of ocular morbidity was 29.35%. It was 28.65% in urban schools and 30.05% in rural schools. The children with ocular morbidity (1420) were also divided according to the four age groups. Maximum children with ocular morbidity (38.03%) were in Group 4, followed by 33.80% in Group 3, 26.25% in Group 2, and minimum 17.83% in Group 1 [Tables 2 and 3].

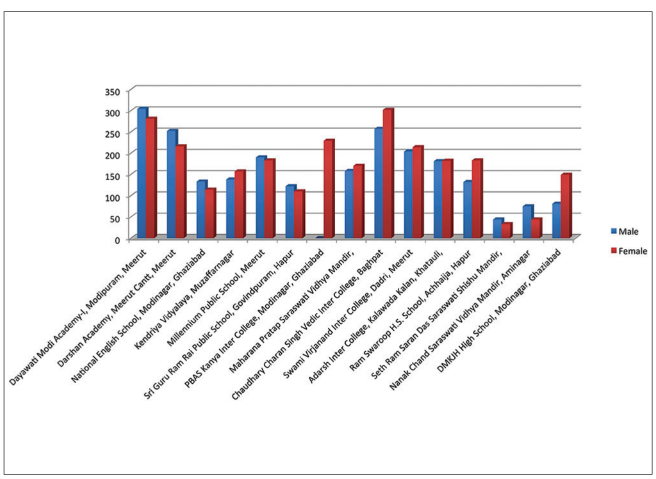

Figure 1: Distribution of children according to schools

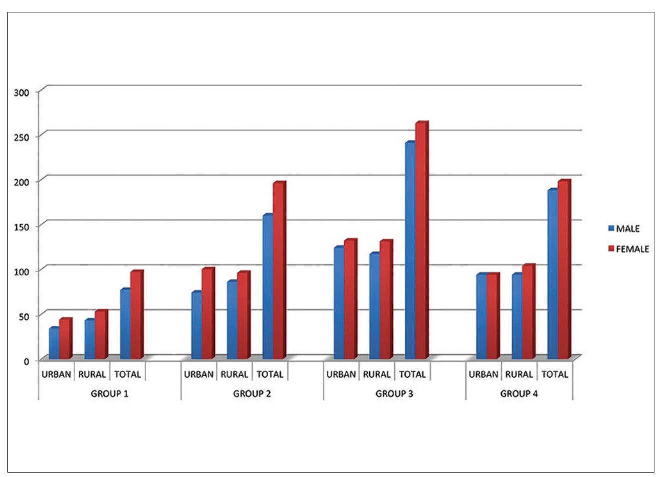

Figure 2: Age group and gender-wise distribution of children

Table 1: Distribution of children in schools in rural and urban areas

School category	Number of children (%)
Urban	2429 (50.21)
Rural	2409 (49.79)
Total	4838 (100.0)

Out of the 1420 children with ocular morbidity, 666 (29.33%) were males and 754 (29.37%) were females. Maximum percentage of males (38.21%) and females (37.86%) with ocular morbidity was in Group 4. Minimum percentage of males (17.70%) and females (17.93%) with ocular morbidity was in Group 1. There was no statistically significant relationship between sex and ocular morbidity, with a $P > 0.05$ [Tables 3 and 4].

Table 2: Distribution of children having ocular morbidity in different age groups

School category	Age group	Ocular morbidity present (%)	Ocular morbidity absent (%)	Total
Urban	Group 1	78 (16.85)	385 (83.15)	463
	Group 2	174 (24.82)	527 (75.18)	701
	Group 3	256 (32.20)	539 (67.80)	795
	Group 4	188 (40.00)	282 (60.00)	470
	Total	696 (28.65)	1733 (71.35)	2429
Rural	Group 1	96 (18.71)	417 (81.29)	513
	Group 2	182 (27.79)	473 (72.21)	655
	Group 3	248 (35.63)	448 (64.37)	696
	Group 4	198 (36.33)	347 (63.67)	545
	Total	724 (30.05)	1685 (69.95)	2409
Total	Group 1	174 (17.83)	802 (82.17)	976
	Group 2	356 (26.25)	1000 (73.75)	1356
	Group 3	504 (33.80)	987 (66.20)	1491
	Group 4	386 (38.03)	629 (61.97)	1015
	Total	1420 (29.35)	3418 (70.65)	4838

Table 3: Distribution of children having ocular morbidity according to age group and gender

Age group (years)	School category	Gender	Ocular morbidity present (%)	Ocular morbidity absent (%)	Total (%)
Group 1 (5-7)	Urban	Male	34 (17.09)	165 (82.91)	199 (42.98)
		Female	44 (16.67)	220 (83.33)	264 (57.02)
	Rural	Male	43 (18.22)	193 (81.78)	236 (46)
		Female	53 (19.13)	224 (80.87)	277 (54)
	Total	Male	77 (17.7)	358 (82.3)	435 (44.57)
		Female	97 (17.93)	444 (82.07)	541 (55.43)
Group 2 (8-10)	Urban	Male	74 (22.16)	260 (77.84)	334 (47.65)
		Female	100 (27.25)	267 (72.75)	367 (52.35)
	Rural	Male	86 (26.46)	239 (73.54)	325 (49.62)
		Female	96 (29.09)	234 (70.91)	330 (50.38)
	Total	Male	160 (24.28)	499 (75.72)	659 (48.6)
		Female	196 (28.12)	501 (71.88)	697 (51.4)
Group 3 (11-13)	Urban	Male	124 (33.33)	248 (66.67)	372 (46.79)
		Female	132 (31.21)	291 (68.79)	423 (53.21)
	Rural	Male	117 (37.38)	196 (62.62)	313 (44.97)
		Female	131 (34.2)	252 (65.8)	383 (55.03)
	Total	Male	241 (35.18)	444 (64.82)	685 (45.94)
		Female	263 (32.63)	543 (67.37)	806 (54.06)
Group 4 (14-15)	Urban	Male	94 (40.17)	140 (59.83)	234 (49.79)
		Female	94 (39.83)	142 (60.17)	236 (50.21)
	Rural	Male	94 (36.43)	164 (63.57)	258 (47.34)
		Female	104 (36.24)	183 (63.76)	287 (52.66)
	Total	Male	188 (38.21)	304 (61.79)	492 (48.47)
		Female	198 (37.86)	325 (62.14)	523 (51.53)

The most common cause of ocular morbidity was refractive error (17.36%) followed by convergence insufficiency (2.79%), blepharitis (2.11%), Vitamin A deficiency (2.09%), allergic conjunctivitis (1.92%), bacterial conjunctivitis (0.95%), amblyopia (0.41%), stye (0.31%), squint (0.27%), and chalazion (0.27%). Refractive error was the most common ocular disorder seen in 396 (17.44%) males and 444 (17.30%) females. Subanalysis of different types of refractive errors was not done [Table 5a]. Rural schools showed an insignificantly higher (P = 0.96) prevalence of ocular morbidity (30.05%) [Table 5c] as compared to Urban schools (28.65%) [Table 5b]. On individual disease comparison, Vitamin A deficiency was present in 28 (1.15%) children in urban schools and 73 (3.03%) children in rural schools. This difference was statistically significant with $P = 0.0001$. Refractive error was present in 18.36% children in urban and 16.36% children in rural population. This difference was statistically insignificant ($P > 0.05$). All other ocular morbidities were also compared, but the differences were statistically insignificant for each disease [Table 6].

Overall, the ocular morbidity was more in children aged 11–15 years (35.51%), and as the age decreased, the ocular

Table 4: Distribution of children having ocular morbidity according to gender

School category	Gender	Ocular morbidity present (%)	Ocular morbidity absent (%)	Total number of children
Urban	Male	326 (28.62)	813 (71.38)	1139
	Female	370 (28.68)	920 (71.32)	1290
	Total	696 (28.65)	1733 (71.35)	2429
Rural	Male	340 (30.04)	792 (69.96)	1132
	Female	384 (30.07)	893 (69.93)	1277
	Total	724 (30.05)	1685 (69.95)	2409
Total	Male	666 (29.33)	1605 (70.67)	2271
	Female	754 (29.37)	1813 (70.63)	2567
	Total	1420 (29.35)	3418 (70.65)	4838

Table 5a: Overall distribution of children according to gender showing prevalence of different types of ocular morbidity

Ocular disease	Overall		
	Male (n=2271), n (%)	Female (n=2567), n (%)	Total number of children (n=4838), n (%)
Refractive error	396 (17.44)	444 (17.30)	840 (17.36)
Convergence insufficiency	61 (2.69)	74 (2.88)	135 (2.79)
Blepharitis	47 (2.07)	55 (2.14)	102 (2.11)
Vitamin A deficiency	47 (2.07)	54 (2.10)	101 (2.09)
Allergic conjunctivitis	49 (2.16)	44 (1.71)	93 (1.92)
Bacterial conjunctivitis	20 (0.88)	26 (1.01)	46 (0.95)
Squint without amblyopia	5 (0.22)	5 (0.19)	10 (0.21)
Squint with amblyopia	1 (0.04)	2 (0.08)	3 (0.06)
Other causes of amblyopia	9 (0.40)	8 (0.31)	17 (0.35)
Stye	6 (0.26)	9 (0.35)	15 (0.31)
Chalazion	3 (0.13)	10 (0.39)	13 (0.27)
Corneal/conjunctival foreign body	4 (0.18)	6 (0.23)	10 (0.21)
Ptosis	3 (0.13)	3 (0.12)	6 (0.12)
Pterygium	4 (0.18)	0	4 (0.08)
Corneal opacity	2 (0.09)	3 (0.12)	5 (0.10)
Cataract	2 (0.09)	1 (0.04)	3 (0.06)
Nystagmus	1 (0.04)	2 (0.08)	3 (0.06)
Insect bite	0	2 (0.08)	2 (0.04)
Retinal detachment	1 (0.04)	0	1 (0.02)
Optic atrophy	1 (0.04)	0	1 (0.02)
Dacryocystitis	0	3 (0.12)	3 (0.06)
Coloboma	0	1 (0.04)	1 (0.02)
Pseudophakia	2 (0.09)	1 (0.04)	3 (0.06)
Retinitis pigmentosa	1 (0.04)	1 (0.04)	2 (0.04)
Phthisis bulbi	1 (0.04)	0	1 (0.02)
Number of children with ocular morbidity	666 (29.33)	754 (29.37)	1420 (29.35)
Total number of children	2271 (46.94)	2567 (53.06)	4838

Table 5b: Distribution of children according to gender showing prevalence of different types of ocular morbidity in urban schools

	Urban schools		
Ocular disease	Male (*n*=1139), *n* (%)	Female (*n*=1290), *n* (%)	Total number of children (*n*=2429), *n* (%)
Refractive error	211 (18.53)	235 (18.22)	446 (18.36)
Convergence insufficiency	27 (2.37)	39 (3.02)	66 (2.72)
Blepharitis	22 (1.93)	24 (1.86)	46 (1.89)
Vitamin A deficiency	12 (1.05)	16 (1.24)	28 (1.15)
Allergic conjunctivitis	23 (2.02)	22 (1.71)	45 (1.85)
Bacterial conjunctivitis	9 (0.79)	10 (0.78)	19 (0.78)
Squint without amblyopia	3 (0.26)	3 (0.23)	6 (0.25)
Squint with amblyopia	1 (0.09)	1 (0.08)	2 (0.08)
Other causes of amblyopia	3 (0.26)	6 (0.47)	9 (0.37)
Stye	3 (0.26)	3 (0.23)	6 (0.25)
Chalazion	0	4 (0.31)	4 (0.16)
Corneal/conjunctival foreign body	3 (0.26)	3 (0.23)	6 (0.25)
Ptosis	3 (0.26)	1 (0.08)	4 (0.16)
Pterygium	1 (0.09)	0	1 (0.04)
Corneal opacity	1 (0.09)	0	1 (0.04)
Cataract	0	0	0
Nystagmus	1 (0.09)	0	1 (0.04)
Insect bite	0	1 (0.08)	1 (0.04)
Dacryocystitis	0	1 (0.08)	1 (0.04)
Coloboma	0	0	0
Pseudophakia	2 (0.18)	1 (0.08)	3 (0.12)
Retinitis pigmentosa	0	0	0
Retinal detachment	1 (0.09)	0	1 (0.04)
Optic atrophy	0	0	0
Phthisis bulbi	0	0	0
Number of children with ocular morbidity	326 (28.62)	370 (28.68)	696 (28.65)
Total number of children	1139 (47)	1290 (53)	2429

morbidity also decreased (22.73% in children aged 5–10 years). This relationship was statistically insignificant ($P = 0.565$). Urban and rural school categories showed a similar pattern when considered separately. On comparing the diseases individually, the prevalence of refractive error was more in the children aged 11–15 years (21.63%) when compared with children aged 5–10 years (12.78%). This difference was statistically significant with $P < 0.05$. Similarly, convergence insufficiency was more prevalent in children aged 11–15 years (4.67%) when compared with children aged 5–10 years (0.77%). Strabismic amblyopia (0.12%), chalazion (0.52%) and pseudophakia (0.12%) were found to be present only in the 11–15 years age group with no children in the 5–10 years age group having the same. Stye was more prevalent in children aged 11–15 years (0.52%) as compared to children aged 5–10 years (0.09%). All of these differences were statistically significant with $P < 0.05$. All other diseases were also compared, but the differences were statistically insignificant [Table 7].

In the present study, the prevalence of visual impairment was 4.9/1000 children or 0.49% (24 out of 4838), and prevalence of childhood blindness was 0.62/1000 children (3 out of 4838). No blind children were found in urban schools, but a blindness prevalence of 1.2/1000 children (3 out of 2409) was seen in the rural school category. Visual impairment prevalence was 0.62% in rural schools and 0.37% in urban schools.

Discussion

In the present study, a total of 4838 students were examined. There were 2271 males and 2567 females. The prevalence of ocular morbidity was 29.35% with 29.33% in males and 29.37% in females. These results were comparable with a Delhi-based study conducted by Kumar *et al.*,[13] who reported a 22.7% prevalence. Gupta *et al.*[14] reported a similar 31.6% prevalence in Shimla. A study by Chaturvedi and Aggarwal[15] reported a 40% prevalence, which was also comparable with our study. International studies conducted by Lu *et al.*[16] in Tibet and Shrestha *et al.*[17] in Kathmandu reported an overall prevalence of ocular morbidity as 18.36% and 34.2%, respectively. Both were comparable with our study.

Nepal *et al.*[18] found a lower prevalence of 11%. Prajapati *et al.*[19] in a Gandhinagar-based study reported a 13% prevalence. In the Kariapatti pediatric eye evaluation project initiated by Arvind Eye Hospitals, Nirmalan *et al.*[20] found a prevalence of 13.6%. These results were not comparable with our study. This could possibly be due to differences in the sample size, and also differences in the prevalence of ocular

Table 5c: Distribution of children according to gender showing prevalence of different types of ocular morbidity in rural schools

Ocular diseases	Rural schools		
	Male (*n*=1132), *n* (%)	Female (*n*=1277), *n* (%)	Total number of children (*n*=2409), *n* (%)
Refractive error	185 (16.34)	209 (16.37)	394 (16.36)
Convergence insufficiency	34 (3.00)	35 (2.74)	69 (2.86)
Blepharitis	25 (2.21)	31 (2.43)	56 (2.32)
Vitamin A deficiency	35 (3.09)	38 (2.98)	73 (3.03)
Allergic conjunctivitis	26 (2.30)	22 (1.72)	48 (1.99)
Bacterial conjunctivitis	11 (0.97)	16 (1.25)	27 (1.12)
Squint without amblyopia	2 (0.18)	2 (0.16)	4 (0.17)
Squint with amblyopia	0	1 (0.08)	1 (0.04)
Other causes of amblyopia	6 (0.53)	2 (0.16)	8 (0.33)
Stye	3 (0.27)	6 (0.47)	9 (0.37)
Chalazion	3 (0.27)	6 (0.47)	9 (0.37)
Corneal/conjunctival foreign body	1 (0.09)	3 (0.23)	4 (0.17)
Ptosis	0	2 (0.16)	2 (0.08)
Pterygium	3 (0.27)	0	3 (0.12)
Corneal opacity	1 (0.09)	3 (0.23)	4 (0.17)
Cataract	2 (0.18)	1 (0.08)	3 (0.12)
Nystagmus	0	2 (0.16)	2 (0.08)
Insect bite	0	1 (0.08)	1 (0.04)
Dacryocystitis	0	2 (0.16)	2 (0.08)
Coloboma	0	1 (0.08)	1 (0.04)
Pseudophakia	0	0	0
Retinitis pigmentosa	1 (0.09)	1 (0.08)	2 (0.08)
Retinal detachment	0	0	0
Optic atrophy	1 (0.09)	0	1 (0.04)
Phthisis bulbi	1 (0.09)	0	1 (0.04)
Number of children with ocular morbidity	340 (30.04)	384 (30.07)	724 (30.05)
Total number of children	1132 (47)	1277 (53)	2409

morbidity in different regions of the country and abroad, as compared to the present study.

In our study, there was a rise in ocular morbidity with increasing age, which was comparable with a study conducted by Kumar *et al*.[13] This could be due to increase in awareness among children with age, which enables them to talk about their problems more openly with the doctor, resulting in higher reporting of ocular problems among older children. This could also be attributed to cumulative effect of diseases such as refractive errors and convergence insufficiency, which were more in the older children. There is also a possibly greater exposure in older children, leading to higher incidence of conjunctivitis. However, study conducted by Desai *et al*.[21] reported a decline in the ocular morbidity with increasing age, which did not match with the results of our study. Younger children are either afraid or are unable to express themselves due to which many diseases go unnoticed. Hence, children in younger age group should be regularly, thoroughly, and patiently examined so that early detection can be done and long-term visual impairment reduced.

In the present study, refractive error was the most common cause of ocular morbidity with a prevalence of 17.36%. These results were comparable with Gupta *et al*.,[14] who also found refractive error as the most common disorder, with a prevalence of 22%. Das *et al*.[22] in Kolkata and Desai *et al*.[21] in Jodhpur also reported a similar prevalence of 25.11% and 20.8%, respectively. International studies conducted by Shrestha *et al*.[17,23] reported a similar prevalence of refractive error in their 2006 study (21.9%) and as well as their 2011 study (11.9%) in Nepal. Lu *et al*.[16] also found a comparable refractive error prevalence of 11.07% in Maqin county, China.

The Kariapatti pediatric eye evaluation project,[20] undertaken by Aravind Eye Hospital, Delhi-based study by Chaturvedi and Aggarwal,[15] and Kumar *et al*.'s[13] study showed a lower prevalence than our study, which was 0.55%, 7.4%, and 5.4%, respectively. This difference could be due to different diagnostic criteria used for detection, variance in reading habits and living conditions among various population groups, and a difference in the sample size.

The prevalence of Convergence insufficiency was 2.79% in our study. Pratap and Lal[24] reported a comparable prevalence of 1.72%. Very little data were available on this.

Blepharitis was present in 2.11% children in our study which was comparable to 1.6% prevalence reported by Desai *et al*.[21] in

Table 6: Comparison of ocular morbidity prevalence between urban and rural schools

Ocular diseases	Urban (%)	Rural (%)	*P*
Normal	1733 (71.35)	1685 (69.95)	0.5961
Refractive error	446 (18.36)	394 (16.36)	0.4102
Convergence insufficiency	66 (2.72)	69 (2.86)	0.8941
Blepharitis	46 (1.89)	56 (2.32)	0.3761
Vitamin A deficiency	28 (1.15)	73 (3.03)	0.0001
Allergic conjunctivitis	45 (1.85)	48 (1.99)	0.7775
Bacterial conjunctivitis	19 (0.78)	27 (1.12)	0.3826
Squint without amblyopia	6 (0.25)	4 (0.17)	0.4834
Squint with amblyopia	2 (0.08)	1 (0.04)	0.5605
Other causes of amblyopia	9 (0.37)	8 (0.33)	0.8375
Chalazion	4 (0.16)	9 (0.37)	0.3302
Stye	6 (0.25)	9 (0.37)	0.3960
Ptosis	4 (0.16)	2 (0.08)	0.3914
Pterygium	1 (0.04)	3 (0.12)	0.4114
Foreign body	6 (0.25)	4 (0.17)	0.4834
Corneal opacity	1 (0.04)	4 (0.17)	0.1614
Cataract	0	3 (0.12)	0.1786
Nystagmus	1 (0.04)	2 (0.08)	0.5605
Insect bite	1 (0.04)	1 (0.04)	1.0000
Retinal detachment	1 (0.04)	0	0.3230
Optic atrophy	0	1 (0.04)	0.3230
Dacryocystitis	1 (0.04)	2 (0.08)	0.5605
Coloboma	0	1 (0.04)	0.3230
Pseudophakia	3 (0.12)	0	0.0757
Retinitis pigmentosa	0	2 (0.08)	0.1547
Phthisis bulbi	0	1 (0.04)	0.3230
Total	2429	2409	

Jodhpur. Prajapati *et al*.[19] in 2010 reported a higher prevalence of 15.45%, which was not comparable with our study.

In our study, Vitamin A deficiency in the form of conjunctival xerosis and bitot's spots was seen in 2.09% children. Gupta *et al*.[25] reported bitot's spots in 0.90% children. Kumar *et al*.[13] reported xerophthalmia in 4.1% children. Gupta *et al*.[14] and Desai *et al*.[21] found Vitamin A deficiency prevalence of 1.8% and 5.39% in their respective studies. An international study by Wedner *et al*.[26] in a rural area of Tanzania reported night blindness in 5.3%, bitot's spots in 0.6%, and corneal scars in 0.8% children. Another international study by Nepal *et al*.[18] reported xerophthalmia in 0.36% children. All these results were comparable with our study. Prajapati *et al*.[19] and Chaturvedi and Aggarwal[15] reported a higher prevalence of 30% and 10.6%, respectively. This variance could be due to low socioeconomic status and poor nutritional status of that population.

Our study revealed allergic conjunctivitis to be prevalent in 1.92% children. A study conducted by Lu *et al*.[16] in China reported a somewhat comparable prevalence of 0.65%. Ntim-Amponsah and Ofosu-Amaah[27] reported a lower prevalence of 2 out of 997 children screened in their study. This difference could be due to difference in race, region and weather conditions or due to a smaller sample size in their study.

Bacterial conjunctivitis was found in 0.95% children, similar to a study conducted in Shimla by Gupta *et al*.,[14] which reported a prevalence of 0.8%. Delhi-based study by Kumar *et al*.[13] and Jodhpur-based study by Desai *et al*.[21] reported a higher prevalence of 4.6% and 5%, respectively. This could be due to overcrowding, unhygienic living conditions and practices of slum dwelling children in Delhi.

In our study, the prevalence of strabismus was 0.27%. Similar and comparable prevalence was reported by Desai *et al*.[21] (0.21%), Kariapatti eye survey[20] (0.43%), Kalikivayi *et al*.[28] (0.7%), Ntim-Amponsah and Ofosu-Amaah[27] (0.2%), Wedner *et al*.[26] (0.5%), and Nepal *et al*.[18] (1.63%). A higher prevalence of strabismus was reported by Lu *et al*.[16] (2.49%), Yekta *et al*.[29] (2.02%), Baltimore vision screening project[30] (3.1%), Shrestha *et al*.[17] (3.5%), Gupta *et al*.[14] (2.5%), Pratap and Lal[24] (2.87%), and Chaturvedi and Aggarwal[15] (7.7%).

Amblyopia was 0.41% in our study. Similar reports were submitted by Wedner *et al*.[26] (0.2%), Ntim-Amponsah and Ofosu-Amaah[27] (0.2%), Kalikivayi *et al*.[28] (1.1%), Lu *et al*.[16] (1.02%), Sapkota *et al*.[31] (1.8%), and Preslan and Novak[30] (3.9%).

In our study, stye was present in 0.31% children. This was comparable with 0.21% prevalence reported by Desai *et al*.[21] and 1.3% by Kumar *et al*.[13] Chalazion was found in 0.27% children in our study, similar to 0.25% prevalence reported by Desai *et al*.[21] in their Jodhpur-based study.

The results of other ocular disorders including corneal/conjunctival foreign body, ptosis, pterygium, corneal opacity, cataract, nystagmus, insect bite, retinal detachment, optic atrophy, dacryocystitis, coloboma, pseudophakia, retinitis pigmentosa, phthisis bulbi were comparable with other studies. These were not compared individually due to small number of cases.

In our study, 28.65% children in urban schools and 30.05% of the children in rural schools had ocular morbidity. This difference was not statistically significant ($P = 0.96$).

On individual comparison, Vitamin A deficiency was present in 28 (1.15%) children in urban schools and 73 (3.03%) children in rural schools. This difference was statistically significant ($P = 0.0001$). Studies conducted by Chaturvedi and Aggarwal,[15] and Wedner *et al*.[26] also found a high prevalence of Vitamin A deficiency in the rural population.

Refractive error was present in 18.36% children in the urban population and 16.36% children in the rural population. This difference was statistically insignificant ($P > 0.05$), but similar results were reported by Sapkota *et al*.[31] in Nepal and Padhye *et al*.[32] in Maharashtra, who also found a higher prevalence of refractive error in the urban schools. All other ocular morbidities were also compared between urban and rural schools, but the differences were not statistically significant for each disease.

The World Health Organization (WHO) defines blindness as a corrected VA in the better eye of <3/60.[2] Severe, moderate and mild visual impairment are defined as a corrected VA in the better eye of 3/60–6/60, 6/60–6/18 and >6/18, respectively.[33]

Table 7: Comparison of ocular morbidity prevalence between children 10 years and below versus children 11 years and above

Ocular diseases	Total		*P* value of each morbidity
	5-10 years, *n* (%)	11-15 years, *n* (%)	
Normal	1802 (77.27)	1616 (64.49)	0.2037915
Refractive error	298 (12.78)	542 (21.63)	0.0000019
Convergence insufficiency	18 (0.77)	117 (4.67)	0.0000002
Blepharitis	45 (1.93)	57 (2.27)	0.0713120
Vitamin A deficiency	58 (2.49)	43 (1.72)	0.6220370
Allergic conjunctivitis	62 (2.66)	31 (1.24)	0.0653664
Bacterial conjunctivitis	22 (0.94)	24 (0.96)	0.6725295
Squint without amblyopia	5 (0.21)	5 (0.20)	0.7525850
Squint with amblyopia	0	3 (0.12)	0.0428940
Other causes of amblyopia	5 (0.21)	12 (0.48)	0.1154862
Chalazion	0	13 (0.52)	0.0045840
Stye	2 (0.09)	13 (0.52)	0.0011551
Ptosis	2 (0.09)	4 (0.16)	0.3342611
Pterygium	0	4 (0.16)	0.1142629
Foreign body	6 (0.26)	4 (0.16)	0.6579282
Corneal opacity	2 (0.09)	3 (0.12)	0.4813303
Cataract	3 (0.13)	0	0.2198510
Nystagmus	1 (0.04)	2 (0.08)	0.4513915
Insect bite	0	2 (0.08)	0.1142629
Retinal detachment	0	1 (0.04)	0.2839870
Optic atrophy	0	1 (0.04)	0.2839870
Dacryocystitis	0	3 (0.12)	0.1374273
Coloboma	1 (0.04)	0	0.3741277
Pseudophakia	0	3 (0.12)	0.0428940
Retinitis pigmentosa	0	2 (0.08)	0.1142629
Phthisis bulbi	0	1 (0.04)	0.2839870
Ocular morbidity total	530	890	*P* value of overall morbidity
Total number of children (%)	2332 (22.73)	2506 (35.51)	0.565

In the present study, the prevalence of visual impairment was 4.9/1000 children or 0.49% (24 out of 4838), and prevalence of childhood blindness was 0.62/1000 children (3 out of 4838). As per the WHO estimates, the prevalence of childhood blindness in the world is 0.75/1000 children, and in India, it is 0.8/1000 children.[2] As our survey included only school children, our prevalence rates are slightly less compared to WHO estimates, which included an estimate of all the children in the community. In our study, the causes of blindness included retinochoroidal coloboma, retinitis pigmentosa and optic atrophy whereas the causes of impaired vision included amblyopia, corneal opacity, cataract and nystagmus. These were similar to the results of Kalikivayi *et al*., who found best corrected VA <6/9 in the worse eye to be present in 1.4% children, the causes being amblyopia in 1.1%, corneal diseases in 0.1%, cataract in 0.05% and others in 0.1%. No child was legally or economically blind after refractive correction in their study.[28] Similar results were reported by the Kariapatti pediatric eye evaluation project, which found 6.2 of 10,000 children to be blind in their study.[20] Sapkota *et al*. found best-corrected visual impairment in the better eye to be present in 0.86% children,[31] which was slightly higher than our study. Studies by Dandona *et al*. and Murthy *et al*. have estimated the prevalence of blindness as 1.25/1000 children in rural[9] and 0.53/1000 children in urban areas[10] in the age group of 5–15 years, respectively. We did not find any blind children in the urban schools but found a blindness prevalence of 1.2/1000 children (3 out of 2409) in the rural school category. The prevalence of visual impairment was also more in the rural schools (0.62%) as compared to urban schools (0.37%) in our study.

Conclusion

This study revealed that the most common cause of ocular morbidity was refractive error. The majority of the causes were either treatable or preventable. A simple school screening was an effective and an easy method for early detection of ocular problems. Early detection and management reduces the disease progression and can prevent visual disability. Schools form an effective media where mass communication can be done, and students can be taught about routine eye care and personal hygiene. Teachers of the schools should be briefed about common ocular problems and taught how to identify children with ocular problems, so that they can report the same to the child's guardian and necessary action can be taken in time.

This study was the first of its kind in West Uttar Pradesh reporting the prevalence of pediatric ocular morbidity and providing comprehensive comparative data of the ocular disease pattern prevalent in the schools of urban and rural sectors of the region. It would form a foundation pillar for future planning and management in West Uttar Pradesh. However, children with multiple disabilities, preschool age children, those from lower socioeconomic groups and those from rural communities who did not attend school were likely to be underrepresented. This was the limitation of our study.

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Conflicts of interest

There are no conflicts of interest.

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