Original Research Article

Study on ocular morbidity prevalence and impact of digital display devices among school children

Sridhara Reddy[1],*, Atul Kumar Singh[2]

[1]*Dept. of Ophthalmology, Air Force Central Medical Establishment, New Delhi, India*
[2]*Command Hospital, Bangalore, Karnataka, India*

ABSTRACT

Aim: To estimate the prevalence of ocular morbidity and impact of digital display devices among school children attending Air Force school in Delhi.

Materials and Methods: This was a descriptive cross-sectional study using a quantitative method of data collection and was conducted among primary school children of age group 5-11years in Delhi area. A total of 1100 school-going children were evaluated. After enumeration and questionnaire administration, visual acuity and exposure time of digital display devices noted, followed by examination of anterior and posterior segment structures of the eyes of the children. For the analysis, children were divided into 3 groups: Group 1 (5-7 years), Group 2 (8-10 years) and Group 3 (below 11 years) based on age.

Results: A total of 1100 school children (625 boys and 475 girls) participated in the study. A total of 282 (25.6%) children had visual impairment and 315 (28.6%) children had ocular morbidities. The common ocular morbidities identified were refractive error 25.6%, colour vision defective 0.9%, convergence defect 1.8% and squint 0.2%. The older age group (8-10 yrs) had a higher prevalence of refractive error, especially myopia, compared to the younger age group (5-7 yrs) and group (<12yrs) (P < 0.001).

Conclusion: A high prevalence of ocular morbidity among school children of age group 8-10 yrs was observed with a positive correlation with exposure time to digital display devices. Refractive errors were the most common ocular disorders.

1. Introduction

The global estimation of people with visual impairment is 253 million, among which 217 million have moderate to severe visual impairment. Of these, children under the age of 15 years accounts for 19 million with visual impairment due to undetected or inadequately corrected refractive errors accounting for 12 million.[1]

A poor academic performance is seen in children having undetected ocular disorders and cause severe ocular disability later in life.[2] Visual screening programme of children benefits by giving ready access to the target population. As confirmed by several community based studies approximately 75% of all vision related problems in children were first identified in a visual screening programme.[3]

Early detection and treatment prevents ocular morbidities. Generally children are not aware of their ocular problems and do not complain of defective vision. Children tend to adopt compensatory methods for adjusting to the poor vision by sitting near the blackboard, holding the books closer to their eyes, and squeezing the eyes.[4,5] A statistical data on pattern of causes and prevalence of ocular morbidity in children is essential for implementation of preventive and curative services in children.[6]

The significant data for the study of preventable blindness falls in the school children of age group (6-16 years) accounting for 25% population in developing countries. Schools provide the best platform for imparting health education to the children. Computers and other digital display devices are now an integral part of day to day

* *Corresponding author.*
E-mail address: shrusri13@gmail.com (S. Reddy).

life. With increased popularity of notebooks, tablets, smart phones and e-book readers, use of digital devices is no longer only limited to desktop. In this techno-age, children as young as two years are given touch screen devices like iPads to play and learn with. This study was carried out with the objective of estimating the prevalence of ocular morbidity and the impact of digital display devices among school children.

2. Materials and Methods

This is a cross-sectional study conducted among primary school children in Delhi. The study was conducted in full accord with the tenets of the Declaration of Helsinki after obtaining approval from the Institutional Ethics Committee. Children attending Air Force schools in the age group of 5-11 years were included for the evaluation. The school management committee was informed in prior about the visit and written permission was taken. Permission from parents was as taken after being informed by the respective school teachers. Consent forms and questionnaire were distributed to all the primary school children. The questionnaire included the number of hours of exposure to digital display devices by child per day specifically for television, mobiles and computers and any voluntary disclosure of significant ophthalmological history by parents.

The survey team consisted of an ophthalmologist, medical assistants, and three office assistants with ophthalmic exposure. History taking was done from the children, teachers, and from voluntary disclosure by parents in consent form. Examination was carried out in clean, quiet and well lit rooms within the school campus. Assessment of both aided and unaided visual acuity was done by using Snellen's chart. A pinhole visual acuity was tested for children with visual acuity(VA) less than 6/9. Refractive error was diagnosed when a VA worse than 6/9 improved on pinhole test. As per WHO classification visual impairment was defined as presenting VA worse than 6/9 in the better eye and classified into mild (6/12–6/18), moderate (<6/18–6/60), and severe impairment (<6/60–3/60).[7] Blindness was defined as best corrected VA worse than 3/60 in the better eye.[8–10] A dry retinoscopy and subjective refractive error correction was given to the children. Children were checked for ocular movements and convergence insufficiency using Royal Air Force ruler (RAF). A detailed anterior segment examination was done using a torch light and a slit-lamp. Colour vision was tested in broad daylight by using 32 plates Ishihara charts. Visual axis alignment was checked using cover-uncover, alternate cover and Hirschberg tests. A detailed fundus examination was done using a direct ophthalmoscope. Children not improving to 6/6 with a pinhole and needing further assessment and management were referred to a tertiary care centre.

The data collected from children were divided into 3 groups: Group 1 (5-7 years), Group 2 (8-10 years) and Group 3 (below 11 years), based on age for the analysis. The final data was analysed using SPSS version 16.0 for windows (IBM SPSS, IBM Corp., Armonk, NY,USA).

3. Results

Sample size of the study was 1100 with children in the age group of 5-11 years. Among these 625 (56.8%) were boys and 475 (43.1%) girls. In the study, 785 (71.3%) children had normal ocular findings and ocular morbidity was seen among 315 (28.6%) children.

The prevalence of ocular morbidities seen in the children is tabulated in Table 1. The refractive errors where visual acuity improved with pin hole testing accounted for 282 (25.6%) followed by convergence deficiency accounting for 20 (1.8%) of ocular morbidity. Colour vision defect was responsible for 10 (0.9%) of ocular morbidities, and 03 (0.27%) were due to squint with nil cataract and glaucoma cases.

785 (71.3%) children had normal vision while 282 (25.6%) had impaired vision. Among the children with impaired vision, 199 (70.1%) had mild, 60 (21.8%) had moderate and 23 (8.0%) had severe impairment. Among refractive error a total of 172 (61%) children had myopia, 79 (28%) astigmatism and 3 (11%) of hypermetropia seen in children. The ocular morbidity pattern was 34% in boys as compared to 21.4% in girls which was statistically significant (P < 0.001) [Table 2].

The analysis of ocular morbidity in the three age groups showed that group 2 (37.5%) had a higher prevalence as compared to group 1 (19.8%) and group 3 (29.6%) but this difference was statistically insignificant (P = 0.192) [Table 3]. The only factor that attained a statistically significant difference (P < 0.001) was refractive error. Myopia was noted to be higher in group 2 with 42 children (4.8%). (P= 0.006).

Table 4 shows an average of per day exposure of children to digital display devices viz mobile/tab, television and computer. Children in age group 2 (8 to 10 yrs) showed average exposure of screen time of 06 hours per day followed by group 1 (5 to 7 years) and group 3(<11 years) with average screen time of 4 hours per day. In group 2 and Group 3, exposure to Television was more in comparison to mobile and computers. This data correlated with the increase in ocular morbidity in group 2 (37.5%) compared to group 1 and group 3.

4. Discussion

Sample size of the study was 1100 with children in the age group of 5-11 years. Among these 625 were boys and 475 girls. The prevalence of ocular morbidity was 28.6% with

Table 1: Prevalence of various ocular morbidities

Ocular morbidity	Children (n=1100)	Percentage %	P
Ocular morbidity	315	28.6	0.286
Refractive error	282	25.6	0.256
Colour vision defective	10	0.9	0.009
Convergence Defect	20	1.8	0.018
Squint	03	0.2	0.002

Table 2: Prevalence of ocular morbidity based on gender

Ocular morbidity	Gender		P
	Boys (n= 625)	Girls(n= 475)	
Ocular morbidity	213 (34.0%)	102(21.4%)	0.286
Refractive error	190(30.4%)	92 (19.3%)	0.256
Colour vision defective	10 (1.6%)	0(0)	0.009
Convergence Defect	12(1.9%)	8 (1.6)	0.018
Squint	1(0.1%)	2(0.4)	0.002

Table 3: Various ocular morbidities based on age group

Ocular morbidity	Age Group			P
	Group 1 (n= 344)	Group 2(n= 729)	Group 3 (n=27)	
Ocular morbidity	135 (42.8%)	171(54.2%)	9 (2.8%)	0.286
Refractive error	129(37.5%)	145(19.8%)	8(29.6%)	0.256
Colour vision defective	3(0.8%)	7(0.9%)	0	0.009
Convergence Defect	1(0.2%)	2(0.2%)	0	0.018
Squint	2(0.5%)	17(2.3%)	1(3.7%)	0.002

Table 4: Average hours of exposure to digital display devices per day

Age Group	Group 1 (5-7 yrs)	Group 2 (8-10 yrs)	Group 3 (less than 12 yrs)
Mobile/tab per day (Average)	2	2	1
TV per day (Average)	2	3	2
Computer per day(Average)	0	1	1
Total hours	04	06	04

34% in boys and 21.4% in girls. A varied prevalence reports is noted in previous studies based on data from different geographical areas and methodologies used. The Delhi-based study conducted by Kumar et al.[7] reported a 22.7% prevalence. Gupta et al.[11] in their study reported a 31.6% prevalence in Shimla. A study conducted by Chaturvedi and Aggarwal[12] reported a 40% prevalence which was due to higher prevalence of refractive error in their study. Shrestha et al.[13] in their study in Kathmandu reported an overall prevalence of ocular morbidity as 34.2% which was comparable with our study.

The refractive error was found to be the most common cause of ocular morbidity with a prevalence of 25.6%. These results were comparable with studies conducted by Gupta et al.[11] who found refractive error as the most common disorder, with a prevalence of 22%. International studies conducted by Shrestha et al.[13] reported a similar prevalence of refractive error in their 2006 study (21.9%) and (11.9%) in 2011 study in Nepal. Studies conducted by Das et al.[14] in Kolkata and Desai et al.[15] in Jodhpur also reported a similar prevalence of 25.11% and 20.8%, respectively

Lower prevalence of refractive errors (2.7-5.8%) has been reported internationally among children of age 5-15 years from Africa, Finland, Chile and Nepal as compared to the present study.[16] These differences may be explained by the geographical variations in the prevalence of refractive errors, different lifestyles followed, medical care received, and different diagnostic criteria used in the studies.

The most common refractive error was myopia with a prevalence of 3.2% followed by astigmatism 1.4% and hypermetropia at 0.6%. A similar prevalence of myopia (5.8%) and hypermetropia (0.7%) was reported by Aldebasi et al[17] in their study. In a study conducted by Padhye et al.,[18] they reported a 4.61% prevalence of myopia which was comparable with the present study; however, the prevalence of hypermetropia and astigmatism reported was 1.45% and 0.37%, which was higher than the present study. The studies have shown that a higher prevalence of myopia is associated with an increase in literacy rate, duration of study hours and age of the child.[18]

The difference in the prevalence of ocular morbidities among boys (34%) and girls (21.4%) was due to the higher

prevalence of refractive error in boys (30.4%) than girls (19.3%). The prevalence of red-green colour deficiency was found to be 1.6% which was comparable to results reported by Gupta et al.[11] (2.3%) in their study. The frequency of colour vision defects is higher among male children which corroborate that genetically colour vision is inked recessive nature.

In our study the prevalence of Convergence insufficiency was 1.8% which was comparable to a study conducted by Pratap and Lal[19] who reported a prevalence of 1.72%. The prevalence of squint was 0.27% which was similar and comparable to the prevalence reported in studies conducted by Desai et al.[14] (0.21%). A higher prevalence of strabismus was reported by Shrestha et al.[13] (3.5%), Gupta et al.[11] (2.5%), Pratap and Lal et al[19] (2.87%) in their studies.

The ocular morbidity was more in the Group 2 (8 to 10yrs) compared to Group 1 (5 to 7 yrs) and group 3 (less than 12 yrs) which was comparable with a study conducted by kumar et al.[20] Among older children this could be attributed to the increase in awareness with age which enables them to communicate their problems to the doctor in a better way which in turn leads to higher reporting of ocular problems. The study also showed that per day exposure to screen time is more ie 6 hours in group 2 compared to 4 hours each in group 1 and 3. This could be correlated between increase in screen time to rise in ocular morbidities which is evident in this study. But similar such studies are required to be done to support it further.

5. Conclusion

Refractive error is the most commonest cause of treatable or preventable ocular morbidity according to our study. This study emphasised that a simple school visual screening programme is effective for early detection of ocular problems. Schools form a suitable platform where mass communication and awareness about use of digital display devices can be imparted. The study shows positive correlation between exposure to screen time and rise in ocular morbidities. The early detection of colour vision defects and counselling the parents and children guides them in choosing a suitable academic career. Hence, there is a need for early evaluation and treatment of visual impairment before the vision and academic performance of children is affected. Limitations of the study include the smaller sample size of participants in group 3.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Bourne RR, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: A systematic review and meta-analysis. *Lancet Glob Health*. 2017;5:888–97.
2. Schmidt P, Maguire M, Dobson V, Quinn G, Ciner E, Cyert L. Comparison of preschool vision screening tests as administered by licensed eye care professionals in the vision in preschoolers study. *Ophthalmol*. 2004;111:637–50.
3. Gupta M, Gupta BP, Chauhan A, Bhardwaj A. Ocular morbidity prevalence among school children in Shimla, Himachal, North India. *Indian J Ophthalmol*. 2009;57(2):133–8.
4. Castanes MS. Major review: The underutilization of vision screening (for amblyopia, optical anomalies and strabismus) among preschool age children. *Binocul Vis Strabismus Q*. 2003;18:217–32.
5. Vision screening in school children. Training module. Danish Assistance to the National Programme for Control of Blindness. New Delhi, India.
6. Dandona R, Dandona L, Srinivas M, Sahare P. Refractive error in children in a rural population in India. *Invest Ophthalmol Vis Sci*. 2002;43:615–22.
7. Kumar R, Dabas P, Mehra M, Ingle GK, Saha R. Ocular morbidity amongst primary school children in Delhi. *Health Popul Perspect Issues*. 2007;30:222–9.
8. Bourne RR, Flaxman SR, Braithwaite T, Cicinelli MV. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: A systematic review and meta-analysis. *Lancet Glob Health*. 2017;5:888–97.
9. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bull World Health Organ*. 2008;86:63–70.
10. Naidoo K, Govender P. Case finding in the clinic: Refractive errors. *Community Eye Health*. 2002;15:39–40.
11. Gupta M, Gupta BP, Chauhan A, Bhardwaj A. Ocular morbidity prevalence among school children in Shimla, Himachal, North India. *Indian J Ophthalmol*. 2009;57(2):133–8.
12. Chaturvedi S, Aggarwal OP. Pattern and Distribution of Ocular Morbidity in Primary School Children of Rural Delhi. *Asia Pac J Public Health*. 1999;11(1):30–3.
13. Shrestha RK, Joshi MR, Ghising R, Pradhan P, Shakya S. Ocular morbidity among children studying in private schools of Kathmandu valley: A prospective cross sectional study. *Nepal Med Coll J*. 2006;8:43–6.
14. Desai S, Desai R, Desai NC, Lohiya S, Bhargava G, Kumar K. School eye health appraisal. *Indian J Ophthalmol*. 1989;37:173–5.
15. Das A, Dutta H, Bhaduri G, Sarkar AD, Sarkar K, Bannerjee M. A study on refractive errors among school children in Kolkata. *J Indian Med Assoc*. 2007;105:169–72.
16. Wedner SH. Prevalence of eye diseases in primary school children in a rural area of Tanzania. *Br J Ophthalmol*. 2000;84(11):1291–7.
17. Aldebasi YH. Prevalence of correctable visual impairment in primary school children in Qassim Province, Saudi Arabia. *J Optom*. 2014;7(3):168–76.
18. Khandekar R, Dharmadhikari S, Dole K, Gogate P, Deshpande M, Padhye AS. Prevalence of uncorrected refractive error and other eye problems among urban and rural school children. *Middle East Afr J Ophthalmol*. 2009;16(2):69–74.
19. Pratap VB, Lal HB. Pattern of paediatric ocular problems in North India. *Indian J Ophthalmol*. 1989;37(4):171–2.
20. Kumar R, Dabas P, Mehra M, Ingle GK, Saha R, Kamlesh. Ocular morbidity amongst primary school children in Delhi. *Health Popul Perspect Issues*. 2007;30:171–2.

Author biography

Sridhara Reddy Associate Professor

Atul Kumar Singh Associate Professor