

Causes of Visual Impairment in Children with Low Vision

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ABSTRACT

Objective: To determine the main causes of visual impairment in children with low vision. To assess the need of spectacles and low vision devices (LVDs) in children and to evaluate visual outcome after using their LVDs for far and near distance.

Study Design: Observational study.

Place and Duration of Study: Khyber Institute of Ophthalmic Medical Sciences, Peshawar, Pakistan, from June 2006 to December 2007.

Methodology: The clinical record of 270 children with low vision age 4-16 years attending the Low Vision Clinic were included. All those children, aged 4-16 years, who had corrected visual acuity (VA) less than 6/18 in the better eye after medical or surgical treatment, were included in the study. WHO low vision criteria were used to classify into visually impaired, severe visually impaired and blind. Results were described as percentage frequencies.

Results: One hundred and eighty nine (70%) were males and 81 (30%) were females. The male to female ratio was 2.3:1. The main causes of visual impairment included nystagmus (15%), Stargardt's disease (14%), maculopathies (13%), myopic macular degeneration (11%) and oculocutaneous albinism (7%). The percentages of visually impaired, severe visually impaired and blind were 33.8%, 27.2% and 39.0% respectively. Spectacles were prescribed to 146 patients and telescopes were prescribed to 75 patients. Spectacles and telescope both were prescribed to 179 patients while Ocutech telescope was prescribed to 4 patients.

Conclusion: Retinal diseases nystagmus and macular conditions were mainly responsible for low vision in children. Visually impaired children especially with hereditary /congenital ocular anomalies benefit from refraction and low vision services which facilitate vision enhancement and inclusive education.

Key words: Childhood blindness. Low vision. Low vision devices. Vision 2020. Nystagmus. Stargardt's diseases. Maculopathy. Myopic macular degeneration.

INTRODUCTION

The control of childhood blindness is a priority of "Vision 2020 - the right to sight", a global initiative for the elimination of avoidable blindness.¹ The importance of providing care for children with low vision is recognized by many initiatives, such as Vision 2020, the 2004 Oslo Workshop on low vision and the United Nation's global campaign - 'Education for All'.²

The prevalence and major causes of childhood blindness vary between countries and over time. The prevalence of blindness in children ranges from approximately 0.3/1000 children in affluent regions to 1.5/1000 in the poorest communities.³ Reliable population-based data on the causes of blindness in children are difficult to obtain in developing countries. In middle income countries the pattern of causes is mixed, with retinopathy of pre-maturity emerging as an important cause in Latin America and some Eastern

European countries.^{4,5} Currently un-avoidable causes (the biggest group in affluent countries) include hereditary retinal dystrophies, disorders of the central nervous system, and congenital anomalies. Uncorrected refractive errors cause visual impairment and blindness in all regions, particularly myopia in south East Asia.⁶

The prevalence of childhood blindness was 0.3 per 1,000 children in industrialized countries and 1.2 per 1,000 children in the developing countries in the year 2000. Accordingly, it was estimated that there were nearly 1.4 million blind children in the world. Each year, an additional 50,000 children become blind and are added to this pool.⁷ A population-based cross-sectional study in India has found low vision to have a prevalence of 1.05% in the year 2000, with a burden of 10.6 (95% confidence interval, 8.4-12.8) million people requiring low vision services.⁸ In another hospital-based study, the age group < 16 years was the leading age group of low vision.⁹

WHO definition for low vision ($6/60 \leq VA < 6/18$, $10^\circ \leq VF < 20^\circ$),¹⁰ severe vision impairment ($3/60 \leq VA < 6/60$, $5^\circ \leq VF < 10^\circ$), and blindness or profound vision impairment ($VA < 3/60$, $VF < 5^\circ$) are considered reliable.¹⁰

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Many children with incurable visual loss benefit from low-vision rectification services, which facilitate near vision and inclusive education. This study aimed to determine the main causes of low vision in Pakistani children and to assess their visual outcome after using low vision devices for distance and near tasks.

METHODOLOGY

This study was conducted at Low Vision Clinic in Khyber Institute of Ophthalmic Medical Sciences, Hayatabad Medical Complex, Peshawar, Pakistan. The clinical record of 270 children, aged 4-16 years, attending the low vision clinic from June 2006 to December 2007 were included in the study. They were seen first by ophthalmologists and then referred to low vision clinic for assessment, where they are refracted and assessed for LVDs by an optometrist. Optometric examination included detailed history of the patient, his/her family history, functional, occupational and clinical assessment. The anterior segment examination was performed using a slit-lamp. Posterior segment examination was performed by direct or indirect ophthalmoscopy after mydriasis. The diagnosis was confirmed by at least one ophthalmologist and one optometrist.

Distance visual acuity was measured using a range of techniques. Those included Lea symbols, Snellen charts and logarithm of the minimum angle of resolution (Log.MAR) chart with five optotypes on each line at 4 m and, if necessary, at 3, 2 m on each eye separately while the patient wear his or her current spectacles (if worn). Feinbloom chart for the partially sighted and Illiterate E were used for patient who could not read English, depending on the level of co-operation. If visual acuity could not be measured with these charts, a sequential approach was used with fingers counting, hand movement, and light perception. Visual fields were assessed by confrontation and arc perimeter. Refraction with cycloplegia was carried out on all patients, followed by subjective refraction using standard techniques. The best corrected distance and near acuity, the refractive error and eye to chart distance were recorded for each eye.

For near visual acuity "Near Reading Card for the partially sighted" by William Feinbloom and Lea Cards for near visual acuity were used. For the purpose of this study near acuity was banded in three groups; 1M (news paper size) or better which would allow access to most printed materials, < 1M to 3.2 M (display materials) which would allow only limited access to ink print; and < 3.2 M.⁹ Low vision devices like telescopes stand and hand magnifiers, and closed circuit television were used during the low vision assessment. The category of visual impairment was classified by vision in the better eye for all untreatable causes other than uncorrected refractive error.

All these variables were translated into SPSS version 10 databsae. Mean values and standard deviation were calculated for continuous variables while proportions and percentages were calculated for categorical variables.

RESULTS

Two hundred and seventy children aged 4-16 years were assessed at low vision clinic. Mean age was 11 ± 2.8 years. Among the children examined, 189 (70%) were males and 81(30%) were females. The leading cause of low vision amongst this group was nystagmus (15%) followed by Stargardt's maculopathies (14%). The next most common cause was maculopathies (other than Stargardt's disease) (13%) followed by myopic macular degeneration (11%), oculocutaneous albinism (7%), and amblyopia (6%). As a whole retinal disease, including Stargardt's disease and maculapathies, was the major cause of visual impairment present in 32% children. Retinitis pigmentosa was found in 3% cases. The causes of vision impairment are given in Table I.

Table I: Causes of vision impairment.

Causes	Number	Percentage
Nystagmus	40	14.8
Stargardt's disease	37	13.7
Myopic degeneration	30	11.1
Maculopathies	36	13.3
Others (< 2%)	32	11.9
Oculocutaneous albinism with nystagmus	18	6.7
Amblyopia	17	6.3
Retinitis pigmentosa	9	3.3
Marfan's syndrome	6	2.2
Congenital cataract	8	3.0
Optic atrophy	6	2.2
Corneal opacities	6	2.2
Congenital glaucoma	6	2.2
Rod cone dystrophy	6	2.2
Unknown	13	4.8
Total	270	100

Based on vision at initial examination, 3 patients (1.1%) had VA 6/18. Two of them had retinitis pigmentosa while one had Stargardt's disease. On presentation 116 children (43%) had visual impairment (having visual acuity < 6/18 to 6/60 in the better eye), and 62 children (23%) were severely visually impaired (with visual acuity < 6/60 to 3/60 in the better eye) while 89 children (33%, 95%CI) were blind (having VA < 3/60 in the better eye) according to the WHO categories of visual loss. With best correction, 42 (15.6%) children achieved VA 6/18 or better. One hundred and sixty four (60.7%) were visually impaired and 31 (11.5%) were severely visually impaired while 33 (12.2%) of children continued to be blind. Amongst 270 children, 42 were prescribed only glasses for distance while the remaining 228 children were assessed for low vision devices. With low vision

devices, amongst 228 children, 192 children (84.2%) achieved distance visual acuity 6/18 or better in the better eye while 13 patients (5.7%) were visually impaired and 23 (10.1%) remained in the blind category. The distribution of visual acuities is given in Table II. On presentation the difference in percentage amongst male and female was not very significant regarding categories of visual impairment, severe visual impairment and blindness (Table III).

Table II: Distribution of presenting distance VA (visual acuity), best corrected VA and VA with LVDS (low vision devices) (n = 228).

VA	Presenting VA n (%)	Best corrected VA n (%)	VA with LVDS n (%)
6/18 or better	0 (0.0)	0 (0.0)	192 (84.2)
< 6/18 to 6/60	77 (33.8)	164 (72.0)	13 (5.7)
< 6/60 to 3/60	62 (27.2)	31 (13.6)	0 (0)
< 3/60	89 (39.0)	33 (14.4)	23 (10.1)
Total	228 (100)	228 (100)	228 (100)

Table III: Presenting visual acuity and visual acuity with low vision devices by gender (n = 228).

	VA on presentation		VA with low vision devices	
	Male n (%)	Female n (%)	Male n (%)	Female n (%)
6/18 or better	0 (0)	0 (0)	137 (87.0)	55 (78.6)
< 6/18 to 6/60	54 (34)	23 (33)	7 (4)	6 (8.6)
< 6/60 to 3/60	41 (26)	21 (30)	0 (0)	0 (0)
< 3/60	63 (40)	26 (37)	14 (9)	9 (12.8)
Total	158 (100)	70 (100)	158 (100)	70 (100)

Table IV: Near visual acuity at presentation and with low vision aids (n = 270).

VA	Presenting near VA n (%)	Near VA with LVDS n (%)
1M or Better	134 (53.1)	239 (93.8)
< 1 M to 3.2M	62 (31.3)	5 (0)
< 3.2 M	74 (15.6)	26 (6.2)
Total	270 (100)	270 (100)

The results from near visual acuity measurements are shown in Table IV. One hundred and thirty four patients (49.6%) with low vision were able to discern 1 M (newspaper print) or better in the better eye without near addition. Sixty two had near visual acuity < 1 M to 3.2 M and 74 had < 3.2 M. With low vision aids the number of children with near visual acuity of 1 M (0.8 print size) or better increased to 239 (88%), and 26 patients (9.6%) had < 3.2 M.

Spectacles were prescribed to 146 patients and telescopes were prescribed to 75 patients. Spectacles and telescope both were prescribed to 179 patients while Ocutech telescope were prescribed to four patients. Forty six patients were feeling better with filters. For near visual acuity, glasses (included prismatic glasses) were prescribed to 96 patients, stand magnifiers to 42 patients, hand-held magnifier to 27 patients and CCTV and Ocutech telescope with cap to 2 patients each.

DISCUSSION

Children with low vision can improve their quality of life through vision rehabilitation services to teach them how to use their remaining vision more effectively. Using a variety of visual and adaptive aids may bring them back or help them keep their independence. Integrated education of visually impaired children is now preferred when possible. Various studies have found low vision devices as an effective means of providing visual rehabilitation.¹¹⁻¹³

In the present study, hereditary / congenital ocular anomalies (mainly Stargardt's disease and oculocutaneous albinism) accounted for 21% of low vision patients. The reason for the high proportion of hereditary / congenital anomalies in this study may be due to inter-family marriages because consanguineous marriages are common in this part of the world. Most of these hereditary / congenital conditions are not treatable but prevention is possible through genetic counselling. Gothwal has been shown that in the subjects aged < 30 years the leading causes of low vision were genetic.⁹

Prior to refraction, 3 children had a visual acuity $\geq$ 6/18, with 42 (15.6%) more children moving from the group with low vision, but having useful residual vision, improving to the no impairment group after accurate refraction but none of them improved to 6/12 or better in the better eye. This greater number was due to the fact that in the retinal diseases, including Stargardt's disease and maculopathies, vision is good in early childhood but deteriorate with the passage of time. This also illustrates the importance of accurate refraction in children with low vision and shows that, even in the absence of a special low vision services, many eye units can help many children with low vision by providing accurate refraction services. Moreover, children with corrected VA of 6/18 or better but having obvious cause of visual impairment should be considered for follow-up as their VA will deteriorate with age. Refractive error is also one of the most common causes of visual impairment. Due to uncorrected refractive error, there are 145 million people with VA ranging from < 6/18 to 3/60 and 8 million people who are blind (VA < 3/60).¹⁴

In this study the number of male children is more than twice the number of female children. Other studies undertaken by the author did show that the number of male is more than twice the number of female.^{9,11} Girls have poorer access to low vision care than boys. Many factors may contribute towards the fewer females referral. These include comparatively small number of female patients examined in the out patients department; very low literacy ratio in females; long distances involved for visiting the only low vision clinic in the province.⁹ Girls may therefore, need to be approached directly for eye care and not only indirectly via community leaders.

This study showed that even with low vision aids in female, 8.6% had visual impairment and 12.8% were blind while in male 4.0% were visually impaired and 9.0% were still blind. However, there was none in the category of severe visual impairment in both male and female after low vision aids. Hence the percentage of visually impaired and blind remained greater in female as compared to male even with low vision aids. This finding shows that females have significantly higher odds of having severe impairment and blindness which may be reflective of their relatively disadvantaged social status.

In this study, out of 16 patients with amblyopia, 12 had visual impairment and 3 were in the blind category. VA was enhanced to 6/18 or better with LVDs in all cases. In our other studies amblyopia is a major cause of visual defects in children.^{9,15} It is estimated that amblyopia affects between 1-4% of the world's population.¹⁶ Amblyopia develops during the sensitive period of visual maturation, which continues until about 8 years of age.¹⁷

In this study we found that about 50% children had normal near visual acuity. These children thus had sufficient near vision to read the print used in school books. Most visually impaired children have useful sight but there is under provision of visual aids, inadequate training in their uses, specially use of stand magnifiers, and poor understanding of simple methods of visual function for daily living. For low vision devices to be used effectively by children, support, follow-up, training and motivation is needed. With higher power devices, specially stand magnifiers, more supervised practice and greater motivation is required.

The overall visual function of a child has four major components; communication, mobility, daily living activities and sustained near vision tasks like reading and writing, including colour vision and contrast sensitivity assessment.¹⁸ Changes in environment do not cost much and should be an integral part of the low vision care of these children.

Comparison of causes of severe visual impairment (SVI) and blindness in this age group needs to be interpreted cautiously, as the data are not population-based and only a small proportion of low vision children who attended the Low Vision Clinic are presented in this study. The study results are, therefore, likely to differ from whole population studies.

Though the need for low vision aids may have been underestimated in the present study (due to the use of high addition plus / microscopic lenses and prismatic / Fonda glasses), which is affordable and easily available option in our setting. High powered near spectacles can be readily manufactured using conventional aspheric lenses.

CONCLUSION

The present study shows that hereditary / congenital ocular anomalies (mainly Stargardt's disease and oculocutaneous albinism) were more common in these children. On the basis of the analysis made in the study we concluded that visually impaired children especially with hereditary / congenital ocular anomalies benefit from accurate refraction and low vision services which facilitate vision enhancement and inclusive education in these children.

REFERENCES

1. World Health Organization. Preventing blindness in children: report of WHO/IAPB scientific meeting. Geneva: WHO; 2000.
2. Toward a reduction in the global impact of low vision [Internet]. New York: The International Society for low vision research and rehabilitation; 2005. Available from: <http://www2.nutn.edu.tw/vhc/english/Oslo%20Workshop%20Report.pdf>
3. Gilbert C, Rahi J, Eckstein M, O'Sullivan J, Foster A. Retinopathy of pre-maturity in middle-income countries. *Lancet* 1997; **350**:12-4.
4. Kocur I, Kuchynka P, Rodny S, Barakova D, Schwartz EC. Causes of severe visual impairment and blindness in children attending schools for the visually handicapped in the Czech Republic. *Br J Ophthalmol* 2001; **85**:1149-52. Comment in: p. 1145-6.
5. World Health Organization. Elimination of avoidable visual disability due to refractive errors. Geneva: WHO; 2000.
6. Gilbert C, Foster A. Childhood blindness in the context of vision 2020-the right to sight. *Bull World Health Organ* 2001; **79**:227-32. Epub 2003 Jul 7.
7. Dandona R, Dandona L, Srinivas M, Giridhar P, Nutheti R, Rao GN. Planning low vision services in India: a population-based perspective. *Ophthalmology* 2002; **109**:1871-8.
8. Shah M, Khan MD. Causes of low vision amongst the low vision patients attending the Low Vision Clinic at Khyber Institute of Ophthalmic Medical Sciences (KIOMS), Hayatabad Medical Complex, Peshawar, Pakistan. *J Visual Impairment Res* 2004; **6**: 89-97.
9. World Health Organization. Strategies for the prevention of blindness in national programmes: a primary health care approach. Geneva: WHO; 1984.
10. Shah M, Zaman M, Khan MT, Khan MD. Visual rehabilitation of patients with Stargardt's disease. *J Coll Physicians Surg Pak* 2008; **18**:294-8.
11. Hornby S, Adolph S, Gothwal VK, Gilbert CE, Dandona L, Foster A. Evaluation of children in six blind schools of Andhra Pradesh. *Indian J Ophthalmol* 2000; **48**:195-200.
12. Silver J, Gilbert CE, Spoerer P, Foster A. Low vision in east African blind school students: Need for optical low vision services. *Br J Ophthalmol* 1995; **79**:814-20.
13. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by un-corrected refracted errors in 2004. *Bull World Health Organ* 2008; **86**:63-70. Comment in: *Bull World Health Organ* 2008; **86**(8):B-C; author reply C.

14. Shah M, Rahman H, Khan MT, Khan MD, Habib-ur-Rehman. Clinical profile of amblyopia in Pakistani children age 3 to 14 years. *J Coll Physicians Surg Pak* 2005; **6**:353-7.
15. Simons K. Pre-school vision screening: rationale, methodology and outcome. *Surv Ophthalmol* 1996; **41**:3-30.
16. Newman DK, Hitchcock A, McCarthy H, Moore AT. Pre-school vision screening: outcome of children referred to the hospital eye services. *Br J Ophthalmol* 1996; **80**:1077-82.
17. Hyvarinen L. Assessment of low vision for educational purposes and early intervention [Internet]. [updated 1999]. Available from: <http://www.näkötstit.fi/en/assessme/comenius/index.html>.

