Community Eye Care

Ocular disorders in children with learning disabilities in special education schools of Pune, India

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Aim: The aim was to study and treat ocular disorders in children with learning disabilities (cLDs) and explore associations with their perinatal history. **Materials and Methods:** cLDs attending 11 special schools were examined by a team consisting of an ophthalmologist, optometrist, and a social worker in 2007 and followed up in 2008. The students' intelligence quotient (IQ) and their medical histories were noted. Distant visual acuities were measured using Kay pictures or Snellen's tumbling E chart and complete ocular examination was performed. Students were assessed at the pediatric ophthalmology unit and low vision center, if needed. Statistical analysis was done with SPSS and the Chi-square test for ordinal data. **Results:** A total of 664 students were examined, 526 of whom were <16 years of age; 323 (61.4%) were male. A total of 326 (60%) had moderate-to-severe learning disabilities (IQs <50), and the mean IQ was 45.4. Two hundred and thirty-eight (45.3%) had ocular disorder; 143 (27.3%) had an uncorrected refractive error, followed by strabismus in 83 (15.8%), nystagmus in 36 (6.8%), optic atrophy in 34 (6.5%), and congenital anomalies in 13 (2.5%), 103 children had more than one abnormality. Only 12 of the 143 students with refractive errors were using spectacles. A total of 132 (48.7%) children with a history of perinatal insult had ocular problems. Ocular disorders were also common in those with a history of epilepsy, Down's syndrome, and cerebral palsy. **Conclusion:** Nearly half the cLDs in this study had ocular disorders and one-fourth had their vision improved.

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Vision plays a fundamental role in the acquisition of skills such as language, interpreting facial expressions, and skills requiring hand–eye coordination. If a child continues to have an uncorrected distance visual deficit beyond the age of 10–12 years, the plasticity of the visual system is lost and the recovery of vision can be limited.[1] Without sufficient vision, children are limited in every situation, and untreated vision disorders affect their ability to make informed choices, and learn from the environment.

Several studies have explored ocular and visual disorders in intellectually challenged adults. In the Netherlands, 72.3–92% of adults with intellectual disability had an ocular problem and the prevalence of visual impairment increased with age and the severity of the intellectual disability.[2-8] On the other hand, children with learning disabilities (cLDs, previously referred to as mentally challenged or retarded) are challenging to assess, requiring patience, skills, and a broader range of assessment instruments than normal children. There have been only two studies of cLDs from India which show that ophthalmic conditions such as refractive errors, strabismus, and nystagmus are common.[9,10] World Health Organization (WHO) estimates the prevalence of mental retardation in the general population (across all ages) to be 2%, being 3% in individuals below the age of 18 years.[11] Despite the magnitude of the problem, affected individuals are underserved due to a lack of awareness about their problems, even among healthcare providers.[11]

The presence of more than one disability in an individual can have a multiplicative rather than an additive effect on their life experience.[12] A stormy perinatal period contributes to many medical disorders in children, which may include ocular disorders.[13-15] The aim of this study was to investigate the range, type, and frequency of ocular and visual disorders among children (students <16 years, as defined by WHO) with learning disabilities in special education schools in a city in Maharashtra, India. The co-relation between ocular disorders and perinatal history was also investigated. All treatable disorders were addressed wherever possible and their effects were noted after a year.

Materials and Methods

The principals of all special education schools for children with learning disabilities in Pune city were sent a letter proposing that all students in their school be examined with a view to diagnose and treat eye disorders. The study was approved by the ethical committee of the hospital. All students in the special school were examined by the team of ophthalmologists (senior and resident), optometrists, and a social worker in January–July 2007 and followed up in July–August 2008.

Parents were informed in advance of our visit by the school and their presence was requested during the examination of their child. The examination process was explained to the teachers and their assistance was requested. Teachers and parents were asked to notify the examination team if they had noticed any of the following: the child holds his/her work very close or sits close to the blackboard; squint; drooping eyelids; red eyes; habitual eye rubbing or poking; white spots in the

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eyes; history of night blindness; had spectacles that had been prescribed previously or any other eye health problem.

Prior to admission to the schools, all children have to go through a lengthy certification process and copies of the reports are held by the school. These records were reviewed for each child to ascertain the following: (a) family history, and if so, who in the family was also affected and whether there was a history of consanguinity; (b) level of antenatal care of the mother, categorized as poor (i.e., no antenatal visit), fair (i.e., one antenatal visit), or good (i.e., more than one antenatal visit); (c) details of birth, i.e., whether preterm, term, or postterm, and the type of delivery, i.e., normal, vaginal (instrument assisted), or Caesarian section, birth weight, and whether there was a delay in crying at birth; (d) major medical events, e.g., seizures, jaundice, need for incubator, cyanosis, fever, meningitis, or head injury; and (e) known systemic disorders such as Down's syndrome, epilepsy, cerebral palsy, and attention deficit disorder. Intelligence quotient (IQ) had been assessed earlier using the Binet–Kamat method at the government medical college, which was the official certifying authority.[16] Team members were encouraged to spend time to establish rapport with the child before commencing the examination.

External ocular examination was carried out in diffuse illumination with a flashlight. Head posture, facial anomalies, and ocular motility were noted. Orthoptic examination was performed using Hirschberg's reflex and if this was abnormal, cover/uncover tests were performed. Kay picture tests were used to measure visual acuity in more disabled and younger children. Snellen's chart in English, Marathi (the regional language), or numbers was used for children with less profound LDs. Snellen's "E" chart was used for children who did not know how to read, but were able to interpret symbols.

Subjective correction was attempted on all children who had visual acuity less than 20/30 in either eye. Cycloplegia was only undertaken for children in whom retinoscopy revealed hypermetropia and all children with esotropia or esophoria using cyclopentolate eye drops (0.3%) after ascertaining that the child did not have seizures or behavioral disorders. In such cases, tropicamide (1%) eye-drops were used. If subjective refraction was not possible, the prescription was based on the retinoscopy findings. Glasses were prescribed for all children who required a myopic correction of ≥−1.0 diopter (D), hypermetropic correction of ≥+3.0 D, and/or astigmatism of ≥0.5 D cylinder (C). Children with a visual acuity <20/40 in either eye underwent dilated fundus examination with a direct ophthalmoscope. Teachers were warned about possible complaints of temporary near vision impairment and of glare. Children whose visual acuity did not improve to 20/200 in the better eye were classified as severely visually impaired and those whose vision did not improve to 20/60 were termed visually impaired. The cause of impairment was identified, if more than one cause of impairment was present, the avoidable one was considered.

Children with signs of vitamin A deficiency, ocular surface infections, and hordeolae were provided medical treatment. Spectacles were dispensed to the children within a month. Children requiring specialist attention and whose vision did not improve beyond 20/200 were referred to the pediatric ophthalmology department of the hospital.

In the hospital, visual acuity was tested using a variety of methods depending on the child's response and included Cambridge cards, Cardiff cards, and Lea picture charts. Stereopsis was assessed for all children with manifest or latent ocular deviation. All children underwent slit lamp (hand-held or chair unit) examination by a pediatric ophthalmologist. Children in whom retinal pathology was suspected were examined by indirect ophthalmoscopy after dilating the pupils. The need for low-vision devices was assessed by a specialist using spectacle-mounted, hand-held, or stand magnifiers. The importance of environment modification, especially in relation to contrast and color, was explained to the parents.

All children who had received an intervention (glasses dispensed, surgery or low-vision aids given) were reexamined 1 year later using the same protocol.

Results

A total of 664 students were examined in 11 special schools. This paper presents data from the 526 cLDs who were below the age of 16 years, 323 of whom (61.4%) were male. The mean age was 12.1 years, 114 (21.7%) were below the age of 10 years and 62 had a known family history of learning disability/cognitive impairment. The distribution of IQ scores is presented in Table 1; the mean IQ was 45.4 (range 19–80).

Out of 526 children examined, 238 (45%) had an ocular disorder and 103 children had more than one ocular disorder [Fig. 1]. Visual acuity testing was possible in all but 15 children [Table 2]. All these 15 children underwent the full clinical examination.

After the correction of refractive errors, the causes of bilateral visual impairment (BCVA <20/60) in the 55 children were optic atrophy in 20, congenital anomalies of the disc in 2, cortical visual impairment in 3, ametropic amblyopia in 25, congenital cloudy cornea in 1, pseudophakia with surgical complication in 1, congenital ptosis with amblyopia in 1, and retinal dystrophy in 2. Another 25 children had a unilateral visual impairment due to strabismic amblyopia in 6, microphthalmos with coloboma in 2, optic atrophy in 5, anisometropic amblyopia in 3, macular scar (presumed toxoplasmosis) in 5, and others

Table 1: Distribution of intelligence quotient category in children examined intelligence quotient*

	Category of mental retardation	Number	Percentage
<20	Profound	0	0
20–35	Severe	50	9.5
35–50	Moderate	276	52.5
50–70	Mild	146	27.8
70–85	Borderline intellectual function	6	1.1
85–100	Normal	0	0
Unknown	–	48	9.1
Total		526	100

*IQ (intelligence quotient) categories were those used by World Health Organization.[11,16,30] The Binet–Kamat test was used to measure IQ

4 (include a congenital cataract, a traumatic phthisis, vitamin A deficiency scar and a hypoplastic optic disc).

A total of 210 out of the 526 children aged <16 years underwent a cycloplegic refraction; 143 (26.8%) had refractive errors: 57 (10.5%) were myopic, 56 (10.6%) were hypermetropic, and 30 (5.7%) had astigmatism. IQ and refractive errors were significantly correlated with refractive errors being more common in children with lower levels of IQ (Pearson's *R*, *P* = 0.037). Only 25 of the 143 (17%) children with refractive errors had been previously corrected and only 12 (8.3%) were actually using spectacles.

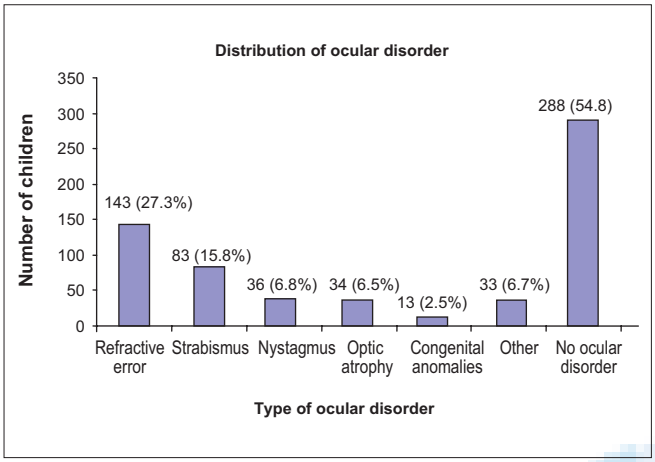

Figure 1: Distribution of ocular disorder in children with learning disability

Table 2: Visual acuity in the learning disabled children

	Better eye		Worse eye	
	Before	After	Before	After
>20/60	359 (68.3)	458 (87.1)	338 (64.3)	433 (82.3)
20/200–20/80	99 (18.9)	37 (7.0)	94 (17.8)	48 (9.1)
20/400–<20/200	35 (6.7)	11 (2.1)	50 (9.5)	15 (2.9)
<20/400	18 (3.4)	7 (1.3)	27 (5.1)	17 (3.2)
Not measured	15 (2.9)	13 (2.5)	15 (2.9)	13 (2.5)
Total	526 (100)	526 (100)	526 (100)	526 (100)

Figures in parentheses are in percentage

Of the 83 (15.7%) children who had strabismus, 45 (54.2%) had exotropia, 38 (45.7%) had esotropia, and 33 children (39.7%) had angles in excess of 30 Δ. Only 43 of the 83 (51.8%) children had an associated refractive error. Nineteen children with strabismus had hypermetropia; another 19 myopia and 5 had astigmatism. In seven children, strabismus was attributed to cranial nerve palsies. Parents of children with strabismus reported that their child faced low social acceptance because of the deviation. The mean IQ of children with strabismus was lower than those without (means 43 and 46, respectively, *P* = 0.021 by the independent *t*-test).

Optic atrophy was present in 34 (6.5%) children, being more common in children with cerebral palsy (9/25, 36%).

Out of 353 children who had a known history of perinatal insult, 164 (46.5%) had an ocular morbidity compared with 72 of 172 (41.9%) among those without a known perinatal insult (by the two-by-two Chi-square test, *P*-value = 0.34). The distribution of perinatal insult in children with a known history is shown in Table 3. Some categories are overlapping.

Systemic conditions included epilepsy (74 children), Down's syndrome (56 children), cerebral palsy (25 children) and speech disorders in 14 children [Table 4]. The history of epilepsy denoted history of convulsions anytime after birth, while postnatal convulsions denoted a history of seizure within the first month after birth. Children with Down's syndrome had highest proportion of visual impairment, 12 of 56 (21.4%). Nine of these children had uncorrected myopia, two were hypermetropic, and one child had bilateral optic atrophy.

A total of 54 children were referred to the hospital for further evaluation and treatment: 30 for strabismus, 6 of whom had surgery; 16 children were offered low-vision aids and 8 children were referred for ptosis, pseudophakic posterior capsular opacification, retinal dystrophy, and cornea disease. Only 2 of the 11 schools visited by us had ever received a visit from an eye care provider, the most recent being 4 years earlier.

Of the 143 children who were refracted and dispensed glasses, 106 (74.1%) were available for examination again after 1 year. A total of 26 children had become more socially active, while 37 were reported by their teachers to have improved in their scholastic activities, e.g., in reading and writing speed,

Table 3: Distribution of ocular disorder in children with history of prenatal insult

Perinatal insult	Number	Refractive error	Strabismus	Optic atrophy	Nystagmus	Others	Total
Poor antenatal care	73	13 (17.8)	15 (20.5)	5 (6.8)	10 (13.7)	6 (8.2)	63
Preterm	68	20 (29.4)	11 (16.2)	9 (13.2)	6 (8.8)	8 (11.8)	68
Delayed cry at birth	157	49 (31.2)	31 (19.7)	19 (12.1)	16 (10.2)	10 (6.4)	152
Assisted/Caesarian birth	84	24 (28.6)	14 (16.7)	8 (9.5)	7 (8.3)	6 (7.1)	73
Low birth weight	105	37 (35.2)	15 (14.3)	8 (7.6)	10 (9.5)	7 (6.7)	96
Fever/meningitis/head injury	59	16 (27.1)	11 (18.6)	5 (8.5)	1 (1.7)	3 (5.1)	38
History of incubator use	42	10 (23.8)	8 (19.0)	5 (11.9)	7 (16.7)	4 (9.5)	43
History of convulsions	32	15 (46.9)	10 (31.3)	5 (15.6)	4 (12.5)	2 (0.6)	43
History of jaundice	35	10 (28.6)	4 (11.4)	3 (8.6)	3 (8.6)	0	24

Figures in parentheses are in percentage

Table 4: Ocular conditions in children with learning disabilities with systemic conditions

Ocular condition	Epilepsy *N* (%)	Down's syndrome *N* (%)	Cerebral palsy *N* (%)
UCVA <20/200	11 (14.9)	12 (21.4)	3 (12)
Refractive error	28 (37.8)	26 (46.4)	7 (28.0)
Strabismus	19 (25.7)	6 (10.7) ET	7 (28.0)
Optic atrophy	5 (6.8)	1 (1.8)	9 (36.0)
Nystagmus	5 (6.8)	3 (5.4)	4 (16.0)
Congenital cataract	–	1 (1.8)	–
Congenital NLD obstruction	–	1 (1.8)	–
Others*	6 (1.3)	–	–
No ocular disorder		6 (10.7)	
Total number	74 (100)	56 (100)	25 (100)

*Typical uveal coloboma, toxoplasma-macular scar, postkeratitis corneal scar. Some children had more than one ocular disorder, UCVA: Uncorrected visual acuity, NLD: Nasolacrimal duct, ET: esotropia

identifying smaller objects, attention span, and handwriting. They had become better at navigation and independent movement. Thirty-seven were told to continue with the same pair of spectacles while 47 needed a new pair.

At the 1-year follow-up visit, 28 of the 106 (26.4%) children were actually wearing their spectacles. Of the 78 who were not wearing the glasses, 13 had broken them, 25 disliked the glasses that were given, and 10 had lost the pair. Three felt the glasses did not fit well and were uncomfortable. Parents of eight children felt that the child did not need the spectacles and thus did not allow the children to use them. Two other children were not given their spectacles to wear because their teachers feared they may injure themselves. It was necessary to conduct a session for the special educators after the screening was completed to explain to them the importance of using the spectacles and of visual stimulation.

Discussion

cLDs emerged as a group with a need for ophthalmologic assessment, only 12 of 143 students with refractive errors were using spectacles. Nearly half the cLDs (45.3%) in this study had ocular disorders and one-fourth had their vision improved with refraction. Half the children with a history of perinatal insult (48.7%) had ocular problems.

This was a first of its kind study of cLDs with a sufficiently large sample size that used the method of school screening so far tried only for "normal" children. As we had taken the entire population of <17-year-old students, rather than a sample, the study had a greater internal validity and since all the schools in the entire Pune region were screened, its external validity was good. The examination of the students was conducted keeping in mind that the children would not respond to chronological age-appropriate tools of assessment, but would require to be assessed by tools for younger children, as was done in Nepal.[17] The cooperation of school staff and establishing a good rapport between the child and the examiner was the keystone of the assessment. All but 15 of the 526 (2.9%) children were found to be responsive to visual acuity testing. It would be ideal if all intellectually challenged children were required to undergo an ophthalmic examination prior to receiving the disability certification from the concerned authorities. The study also gave us a platform for raising awareness levels in the special educators and parents.

Many parents and care providers believed that someone needs to be verbally competent in order to undergo an eye examination. An intellectually challenged child also tends to place a strain on the parents' time, energy, and financial resources. Many parents pragmatically stated that they considered the child to have no economically viable future, so "complicated" examinations were a "waste of time."

The present study found that the most prevalent ocular disorder was refractive errors (27.3%). Bankes found 49% mentally handicapped children had some form of refractive error.[18] Warburg found the prevalence of myopia to be at 43% and of hypermetropia at 21% in severe/profoundly intellectually impaired adults.[4] Van den Broek found refractive errors in 22% of adults with severe and profound multiple disabilities.[3] In a series of 134 intellectually challenged students in Nepal, refractive errors were found in 34.4% in whom the most common type of refractive error was simple hypermetropia[17] compared to 11% ocular morbidity in 1100 normals.[19] The prevalence of refractive errors was much higher than that found in normal children in urban and rural India,[20,21] and in the same population.[22] A significant number of children with learning disabilities had visual impairment only because they had not had a formal eye assessment.

In our study, 46.5% of children with a known history of perinatal insult had some ocular disorder. This establishes that a child with a history of a stormy perinatal period was more likely, even in the population of cLDs, to have ocular and visual health issues. The distribution of the type of ocular disorder varied with the type of perinatal insult suffered.

Children with epilepsy had a high prevalence of refractive errors and strabismus, as did those with Down's syndrome. Data for 55 children with Down's syndrome from Wales who were first examined when they were <2 years showed that only 38% were emmetropic. Of the 24 children with a significant refractive error at the outset, only 6 (25%) showed emmetropization after few years, with 29% prevalence of strabismus.[23] A study of patients with Down's syndrome in Turkey, reported 11 patients (19%) had strabismus and of them 10 (18%) had esotropia with a higher prevalence of hypermetropia.[24] Another recent study from Turkey showed a higher prevalence of strabismus and refractive errors in Down's syndrome.[25]

Cerebral palsy in children has been studied more extensively compared to other subsets of mental subnormality. Optic trophy was probably a result of the anoxic event that caused the cerebral palsy. Katoch *et al.* found that 27 (13.5%) of 200 studied children with cerebral palsy had myopia while 40 (20%) had hypermetropia; optic atrophy was seen in 5.5%, nystagmus in 5.5%, and 78 (39%) had strabismus.[9] Govind *et al.* found that overall 68% of children with cerebral palsy had ocular anomalies, refractive errors accounting for 28.5%, strabismus 35.7%, and optic atrophy for 10%.[10] Strabismus and refractive

errors were common in children with cerebral palsy according to two US studies.[26,27]

This was a cross-sectional study, with only a single follow-up for compliance at the end of 1 year. Children with severe and profound mental retardation were underrepresented. There is a possible gender bias as male children constituted 61% of the sample, which was common in institutionalized children.[28] All children did not undergo a cycloplegic refraction as this would have taken time and there was fear of convulsions where cyclopentolate was used. Subjective refraction was done and might have induced measurement bias. Children who had unaided visual acuity better than 20/30 in each eye were not subjected to refraction. There may have been an underestimation of latent hypermetropia due to this. Near vision was not recorded nor was accommodative lag and reserve considered. Contrast sensitivity and field of vision could not be recorded in the special education schools. There could be a recall bias in stating the perinatal insult, but it would be minimal as the data were collected when the child was admitted to the special education school and based on the medical records which were well-preserved by the parents. The Census of India in 2001 revealed that 2,263,821 persons, i.e., 0.2% of the total population have a mental disability.[29] So the population of intellectually challenged persons who may suffer from some ocular disorder is quite large.

Ophthalmologists are comfortable examining infants and toddlers, but sometimes find themselves uncomfortable when faced with an intellectually challenged child. These children are just infant minds trapped in bodies that grow too fast for their minds to keep up. The visual status of these special children could be improved which would benefit their education and training. All cLDs must undergo annual ophthalmic assessments similar to those carried out in normal schools.

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