

Visual impairment and blindness among children from schools for the blind in Maharashtra state, India: Changing trends over the last decade

Sucheta Kulkarni, Clare Gilbert¹, Nilesh Giri, Pravin Hankare, Kuldeep Dole, M Deshpande

Purpose: To determine the causes of severe visual impairment and blindness in children in schools for the blind in Maharashtra, India. **Methods:** Children aged <16 years, enrolled in the schools for the blind in Maharashtra state, India were examined between October 2018 and December 2019. The anatomical sites and etiology for blindness were recorded using the World Health Organization's standard reporting form. Causes of blindness were compared among different regions of the state and also by different age groups. **Results:** Of the 1,969 students examined from 39 schools for the blind, 188 children (9.5%) had severe visual impairment and 1,666 children (84.6%) were blind. Whole globe anomalies (794, 42.8%) were the most common anatomical site of vision loss in children, followed by corneal (289, 15.6%) and retinal abnormalities (280, 15.2%). Corneal causes were second most common in the poorer districts of Vidarbha (15.3%) and Marathwada (14.6%), whereas retinal causes were second most common in the wealthier regions of western Maharashtra (18.3%) and Khandesh (24.1%). Nearly one-third (593, 32%) of children were blind from potentially avoidable causes. Preventable blindness consisting of corneal causes and retinopathy of prematurity was seen in 281 (15.2%) cases, whereas treatable causes comprising of lens-related causes, glaucomas, refractive errors, amblyopia, and uveitis accounted for another 311 (16.8%). Among the younger children (≤ 10 years), the proportion of corneal blindness was lower (83/623, 13.3% vs. 206/1232, 16.7%) and that of retinal blindness was higher (119/623, 19% vs. 163/1232, 13.2%) than the older children. **Conclusion:** Whole globe anomalies constitute a major cause of SVI and blindness in Maharashtra. There seems to be an increase in the proportion of retinal blindness, especially retinopathy of prematurity, suggesting a need for increased screening coverage.

Key words: Childhood blindness, India, Maharashtra, schools for blind, visual impairment

Childhood blindness is a major public health concern worldwide.^[1] In India, the prevalence of such blindness is estimated to be approximately 0.5/1,000,^[2-4] and at least 210,000 children have severe visual impairment (SVI) or blindness (BL).^[5] Approximately 15,000 are in schools for the blind and nearly half the causes are avoidable.^[2-4,6,7] Such blindness has far-reaching implications in terms of a child's development, education and employment opportunities, the total number of disability-adjusted life years lost, social and functional challenges, and the lifelong burden on the family.^[8,9] Hence, the prevention of blindness in children was a priority of VISION2020: The Right to Sight,^[8] the initiative of the World Health Organization (WHO) and International Agency for the Prevention of Blindness.

Reliable, population-based data on the causes of blindness in children are difficult to obtain in low/middle-income countries as registers of the blind do not exist, and very large sample sizes would be required for population-based surveys. An alternative approach is to examine students

attending schools for the blind.^[10-15] Regional variation in the major causes of blindness reflects differences in socioeconomic development and unequal distribution of and access to healthcare services. In addition, the major causes can change over time, in response to socioeconomic development and the effectiveness of public health programs. Despite an increasing focus on child eye health in India, blindness in children remains a challenge due to diverse cultural practices and beliefs,^[16] socioeconomic barriers to accessing services,^[17] and inadequate services. Therefore, the pattern of childhood blindness must be reviewed periodically to track trends, ascertain the success of current interventions, and for planning future services.

In the present study, conducted from October 2018 through December 2019, we report the causes of blindness and severe visual impairment among children attending schools for the blind in Maharashtra, western India, 12 years after a similar study was published.^[10] This information will help assess trends

Department of Community Ophthalmology and Retina, PBMA's H. V. Desai Eye Hospital, Pune, Maharashtra, India, ¹Department of Clinical Research, London School of Hygiene and Tropical Medicine, London, UK

Correspondence to: Dr. Sucheta Kulkarni, PBMA's H. V. Desai Eye Hospital, Mohammed Wadi Road, Hadapsar, Pune - 411 060, Maharashtra, India. E-mail: drsucheta.kulkarni@gmail.com

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over the last decade and will be useful for program planning in the state.

The state of Maharashtra, which lies on the west coast of India is the wealthiest and most developed state in India, with marked differences in ecology, climate, and prosperity among the different regions, which cover an area of over 300,000 sq km with a population of 123 million of different religious and ethnic groups, including indigenous tribal people.^[18] Marathwada is the most underdeveloped region in the state and western Maharashtra is the most developed.

Methods

The state of Maharashtra was divided into four geographic regions for study purposes, viz w. Maharashtra, Khandesh, Vidarbha, and Marathwada. The study protocol was approved by the Institutional Ethics Committee and adhered to the tenets of the Declaration of Helsinki.

Schools were contacted after obtaining a list from the National Association for the Blind, Mumbai, and the Poona Blind Men's Association, Pune. Permission to examine the children was obtained from the individual school principal. The participant information sheet was sent in advance for the principals to read and they, in turn, informed parents about the study. Parents were given an opportunity to ask questions through written or verbal communication. Written informed consent was obtained from the school principals after they agreed to participate in the study.

Clinical examination

In each school, demographic information was collected from the school records. A brief family history, place of residence, and consanguinity of the parents if relevant were recorded. Information on additional disabilities was obtained from the children's medical records. A detailed eye examination was performed by a team of optometrists and ophthalmologists who had at least 1-year experience of examining children. Distance visual acuity was measured using a Snellen E chart and near-vision was assessed using figures equivalent to N18. If the visual acuity was <6/60, then it was measured successively at shorter distances of 3 m or 1 m; then counting fingers was assessed, and perception and projection of light in four quadrants were tested. Each eye was tested separately. For those with low vision, the functional vision was assessed to determine if the child had a useful residual vision for independent mobility (ability to navigate between two chairs set 2 m apart in a well-lit room), social interaction (ability to recognize faces at a distance of 2 m), and near vision (ability to recognize the shape of three symbols of 2 cm at a near distance) were also measured. The anterior segment was examined using a handheld slit lamp and visual fields were assessed by confrontation. The posterior segment was examined using an indirect ophthalmoscope after dilating the pupils when necessary.

Classification of causes

Major anatomical site leading to visual loss was identified for each eye. If there were more than two abnormalities in the same eye, one major site was selected following the criteria outlined in the Coding Instructions of the WHO Prevention of Blindness (PBL) Eye Examination Record, which emphasizes the selection of treatable or preventable causes.^[19] One site was

selected for the child. If the anatomical sites differed between eyes, criteria in the Coding Instructions were followed. The etiology of the main condition in each eye was determined based on the time of onset of the condition, and then the etiology of the anatomical site selected for each eye and for the child was determined. The etiology was considered unknown when the condition was present since birth and could not be attributed to genetic or intrauterine factors. The need for optical, surgical, or medical interventions was recorded and the visual prognosis assessed. All personal data and clinical findings of each child were recorded on the WHO/PBL Eye Examination Record for Children.^[19] Children requiring further investigations and treatment were referred to the study hospital in Pune. A report of the findings and recommendations were given to the principal of each school.

Definitions

The WHO definitions were used to categorize the causes of SVI and BL, which use the acuity in the better-seeing eye.^[19] The WHO defines blindness as a presenting visual acuity (PVA) of less than 3/60; SVI as PVA of less than 6/60 to 3/60; and moderate vision impairment (MVI) as less than 6/18 to 6/60.^[20]

The term "avoidable" encompasses preventable and treatable conditions. Those amenable to prevention (i.e., where the condition causing blindness could have been prevented) include measles infection, vitamin A deficiency (VAD), ophthalmia neonatorum, the use of harmful traditional eye medication remedies, and congenital rubella syndrome. Conditions that could have been treated early to prevent blindness include glaucoma, cataract, retinopathy of prematurity (ROP), and selected cases of corneal scarring.

Data analysis

All data were entered in Microsoft Excel and analyzed using STATA 12.1 I/c (STATA Corp, Fort Worth, Texas, USA). All continuous variables are presented as means with standard deviations and categorical variables are presented as proportions (*n*, %). Comparisons between categorical variables used Chi-square tests.

Results

Thirty-nine of the 54 schools were enrolled in the study. The rest refused consent due to recent screening by local service providers. Enrolled schools included 16 (41%) in western Maharashtra, 4 (10%) in Khandesh, 10 (26%) in Vidarbha, and 9 (23%) in Marathwada. A total of 1,969 (96.7%) of the 2,035 enumerated students were examined. The mean age was 12.14 years (SD ± 3.3, range: 5–16) and 1,200 (61%) were boys. Western Maharashtra region contributed the largest number of students (850, 43.2%). Table 1 shows the PVA levels of the study participants. The regions in the state have been arranged in all the tables by their level of development, starting with the most developed region in the left column.

A total of 1,666 out of 1969 students (84.6%) were blind, 188 (9.5%) had SVI, and 116 (5.9%) had MVI or better vision. Overall 602 (30.6%) students had no perception of light (NPL) in their better eye, mainly due to whole globe anomalies (313, 51.9%) and corneal blindness (123, 20.5%). The proportion of whole globe anomalies causing NPL was higher in Marathwada compared with western Maharashtra (145/205, 70.7% vs. 109/220, 49.5%). The second most common cause of NPL

Table 1: Presenting visual acuity levels of study participants

Visual acuity in the better eye	W. Maharashtra n (%)	Khandesh n (%)	Vidarbha n (%)	Marathwada n (%)	Total n (%)
6/6-6/18 (no VI)	3 (0.3)	2 (1.0)	12 (2.5)	23 (5.4)	40 (2.1)
6/24-6/60 (moderate VI)	35 (4.0)	6 (2.6)	23 (4.8)	11 (2.7)	75 (3.8)
<6/60-3/60 (severe VI)	66 (8.0)	30 (16.4)	51 (10.4)	41 (9.1)	188 (9.5)
<3/60-light perception (blind)	503 (59.2)	116 (61.1)	252 (51.6)	160 (36.1)	1,031 (52.3)
No light perception	220 (25.8)	36 (18.9)	141 (28.9)	205 (46.5)	602 (30.6)
Not test-believed blind	23 (2.7)	0 (0.0)	9 (1.8)	1 (0.2)	33 (1.7)
Total	850 (100)	190 (100)	488 (100)	441 (100)	1,969 (100)

*VI: Visual impairment

vision differed by regions with corneal blindness (28, 13.6%) in Marathwada and retinal blindness (61, 27.8%) in western Maharashtra.

Overall, 109 (5.5%) students had additional disabilities with hearing loss being the most common (37%) followed by intellectual disability (33%), physical disability (6.1%), epilepsy (7%), and others (16.5%). We report the causes of visual loss in 1,854 children with SVI and blindness.

Anatomical site

Whole globe anomalies were the most common site in all regions [Table 2], affecting 42.8% of students overall. These anomalies were more frequent in poorer Vidarbha and Marathwada regions (43.6% and 61.3%, respectively). Corneal conditions were the second common cause in Vidarbha and Marathwada (15.3% and 14.6%, respectively) and retinal conditions in wealthier regions (western Maharashtra and Khandesh [18.3% and 24.1%, respectively]). Retinopathy of prematurity (ROP), the only avoidable retinal condition affected 1.7% of students. Treatable conditions, principally cataract and glaucoma affected 7.8% and 4.3% of students, respectively. Lesions on the uvea and optic nerve were uncommon as were other conditions (5.3% overall), which included refractive errors, amblyopia, idiopathic nystagmus, etc.

Etiology

The etiology of visual loss was unknown in over three quarters (77.9%) of students and was attributed to hereditary factors in 275 (14.9%), perinatal factors in 61 (3.3%), postnatal factors in 60 (3.2%), and intrauterine factors in 13 (0.7%).

Causes of visual loss were categorized into avoidable (preventable or treatable) and unavoidable [Table 3] as described in methods. Overall, almost a third (32%) of the causes of blindness were avoidable. The western Maharashtra region had a significantly higher proportion of avoidable blindness than Marathwada (35.9% vs. 28.1%, $P=0.001$). A total of 555/1,854 (29.9%) children were referred to the base hospital for further management and surgery was recommended for 160/1,854 (8.6%).

Causes of blindness/SVI were also stratified by age (≤ 10 years and >10 years) to establish a difference in the causes by age group if any [Table 4].

There were no significant differences in the major anatomical site between students above and below 10 years of age, although corneal conditions were slightly higher in older students and retinal conditions were slightly higher in younger children.

The proportion of students blind from ROP was significantly higher in the younger age group (3.2% vs. 0.9%, $P < 0.001$).

Discussion

In this study in Maharashtra, whole globe anomalies were the dominant anatomical site responsible for visual loss. This finding is very similar to the previous study in Maharashtra and has been reported from many other studies in India,^[10-15,21] but less commonly from other countries and regions.^[22]

Failure of normal eye development leading to microphthalmos and anophthalmos form a phenotypic spectrum, either familial or sporadic.^[23,24] These anomalies can be due to the teratogenic effects of maternal viral infections (rubella, toxoplasmosis, cytomegalovirus, etc.),^[25] chromosomal abnormalities, or defective genes affecting embryonic ocular development. The etiology remains unknown in approximately 60% of cases.^[26] The consistent finding that these anomalies are more common in India than elsewhere suggests that the relevant gene variants may be more frequent in the population, and consanguinity, which is not uncommon in India, may also play a role.^[27] Maternal environmental factors (VAD and exposure to pesticides) have been postulated but not proven.^[28]

In a 1998 study, corneal scarring due to vitamin A deficiency and measles were the most common causes of blindness in Indian children.^[7] Studies from 2007 onward show that corneal scarring has declined, with anomalies of the whole eye and retinal causes rising.^[10-13] A similar trend can also be seen in our study; corneal causes declined from 22.2% in the 2007 study in Maharashtra^[10] to 15.6% in the current study. This change can be attributed to increasing coverage of measles immunization and vitamin A supplementation for children, nutrition programs by the government, and socioeconomic development. However, vitamin A supplementation coverage with two doses was only 40%–59% in 2018,^[29] and VAD still remains a public health problem in India.^[30] There is a need to improve primary healthcare and other sustainable interventions to control VAD, such as promotion of breastfeeding, nutrition education, control of endemic diseases, and biofortification (e.g., red maize).

Retinal dystrophies followed by ROP were the two most common retinal conditions. There is some evidence that ROP may be increasing as a cause of blindness. In the 2007 study,^[10] no child was blind from ROP but in the current study, ROP was responsible for a higher proportion of blindness in younger than in older students. This could be because the provision of neonatal care in India has dramatically increased since 2005,

Table 2: Anatomical causes of severe visual impairment and blindness among participants

Major site of abnormality	W. Maharashtra	Khandesh	Vidarbha	Marathwada	Total
Whole globe anomalies	278 (34.2)	69 (37.7)	198 (43.6)	249 (61.3)	794 (42.8)
Microphthalmos	163 (20.1)	23 (12.6)	111 (24.5)	183 (45.2)	480 (25.9)
Anophthalmos	84 (10.4)	24 (13.1)	76 (16.8)	64 (15.8)	248 (13.4)
Disorganized	23 (2.8)	18 (9.8)	1 (0.2)	1 (0.3)	43 (2.3)
Removed	2 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.1)
Other anomalies	6 (0.7)	4 (2.2)	10 (2.2)	1 (0.3)	21 (1.1)
Cornea	135 (16.7)	26 (14.4)	69 (15.3)	59 (14.6)	289 (15.6)
Pthisis	37 (4.6)	8 (4.4)	22 (4.9)	16 (4.0)	83 (4.5)
Corneal scar	37 (4.6)	7 (3.8)	7 (1.5)	15 (3.7)	66 (3.6)
Anterior staphyloma	20 (2.5)	1 (0.6)	6 (1.3)	13 (3.2)	40 (2.2)
Corneal dystrophy	13 (1.6)	3 (1.6)	5 (1.1)	0 (0.0)	21 (1.1)
Keratoconus	6 (0.7)	4 (2.2)	3 (0.7)	5 (1.2)	18 (1.0)
Other corneal opacity	22 (2.7)	3 (1.6)	26 (5.7)	10 (2.5)	61 (3.3)
Lens	74 (9.1)	12 (6.6)	25 (5.5)	33 (8.2)	144 (7.8)
Cataract	42 (5.2)	6 (3.3)	15 (3.3)	16 (4.0)	79 (4.3)
Aphakia	12 (1.5)	0 (0.0)	2 (0.4)	1 (0.3)	15 (0.8)
Other lens abnormalities	20 (2.5)	6 (3.3)	8 (1.8)	16 (4.0)	50 (2.7)
Uvea	28 (3.5)	3 (1.7)	27 (5.9)	5 (1.2)	63 (3.4)
Coloboma	15 (1.8)	2 (1.1)	25 (5.5)	3 (0.7)	45 (2.4)
Aniridia	2 (0.2)	1 (0.6)	2 (0.4)	1 (0.3)	6 (0.3)
Uveitis	2 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.1)
Other uveal abnormalities	9 (1.1)	0 (0.0)	0 (0.0)	1 (0.25)	10 (0.5)
Retina	148 (18.4)	44 (24.1)	66 (14.4)	22 (5.4)	280 (15.2)
Retinal dystrophy	92 (11.4)	35 (19.1)	42 (9.3)	14 (3.46)	183 (9.9)
Stage 5 ROP	14 (1.7)	4 (2.2)	12 (2.6)	1 (0.25)	31 (1.7)
Albinism	5 (0.6)	1 (0.6)	2 (0.4)	1 (0.3)	9 (0.5)
Retinoblastoma	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Other retinal abnormalities	36 (4.4)	4 (2.2)	10 (2.2)	6 (1.48)	56 (3.1)
Glaucoma	45 (5.4)	4 (2.2)	26 (5.7)	5 (1.2)	80 (4.3)
Buphthalmos	35 (4.2)	4 (2.2)	18 (3.9)	5 (1.2)	62 (3.4)
Glaucoma	10 (1.2)	0 (0.0)	8 (1.8)	0 (0.0)	18 (1.0)
Optic Nerve	56 (6.9)	12 (6.6)	21 (4.7)	14 (3.5)	103 (5.6)
Optic atrophy	46 (5.7)	10 (5.5)	19 (4.2)	12 (3.0)	87 (4.7)
Optic nerve hypoplasia	6 (0.7)	2 (1.09)	1 (0.2)	0 (0.0)	9 (0.5)
Other	4 (0.5)	0 (0.0)	1 (0.2)	2 (0.5)	7 (0.4)
Others*	48 (5.8)	12 (6.1)	21 (4.4)	20 (4.7)	101 (5.3)
TOTAL	812 (43.8)	182 (9.8)	453 (24.5)	407 (21.9)	1,854 (100)

*Others include refractive error, amblyopia, cortical blindness, idiopathic nystagmus, etc.

with the provision of at least 800 district level Special Newborn Care units,^[31] and more preterm infants are surviving.^[32] The wealthier regions such as western Maharashtra and Khandesh showed a higher proportion of ROP-related blindness compared with the poorest Marathwada region reflecting more neonatal care facilities. Screening services for ROP need to be scaled up, particularly in the government sector where the majority of preterm infants receive care.^[31-33]

As in other studies, the underlying etiology could not be determined with any degree of certainty in four out of five students.^[10-15] This reflects inadequate medical histories and lack of access to medical records. Hereditary factors accounted for blindness in one in six cases, followed by perinatal and postnatal factors. In contrast, hereditary factors accounted

for 40% of blindness in schools for the blind in Telangana and Andhra Pradesh, possibly due to the higher prevalence of consanguineous marriages.^[14] There is a need for health education regarding consanguinity and genetic risk, bearing in mind the complex social, economic, and cultural factors involved.

Approximately, a third of students were blind from potentially avoidable causes, with roughly equal numbers of preventable and treatable causes. Preventable causes were higher in the 2007 study^[10] (22.2%) and in studies from the north and north-eastern parts of India,^[12,13,34] which suggests that preventive strategies, such as vitamin A supplementation are being effective. Cataract and glaucoma were the most frequent treatable conditions. This suggests that more rigorous

Table 3: Avoidable and unavoidable causes of severe visual impairment and blindness

	W. Maharashtra <i>n</i> (%)	Khandesh <i>n</i> (%)	Vidarbha <i>n</i> (%)	Marathwada <i>n</i> (%)	Total <i>n</i> (%)
Avoidable	292 (35.9)	52 (29.0)	133 (29.6)	116 (28.1)	593 (32.0)
Preventable	130 (16.0)	23 (12.6)	73 (16.1)	56 (13.6)	282 (15.2)
Treatable	162 (19.9)	29 (16.4)	61 (13.5)	59 (14.6)	311 (16.8)
Unavoidable	520 (64.1)	130 (71.0)	320 (70.4)	291 (71.9)	1,261 (68.0)
Total	812 (100)	182 (100)	453 (100)	407 (100)	1,854 (100)

Table 4: Anatomical causes of severe visual impairment or blindness by age group

Major site of abnormality	≤ 10 years <i>n</i> (%)	>10 years <i>n</i> (%)	Total <i>n</i> (%)
Whole globe	245 (39.2)	549 (44.5)	794 (42.8)
Microphthalmos	165 (26.5)	315 (25.6)	480 (25.9)
Anophthalmos	64 (9.9)	184 (14.9)	248 (13.4)
Disorganized	9 (1.4)	34 (2.8)	43 (2.3)
Removed	0 (0.0)	2 (0.2)	2 (0.1)
Other whole globe anomalies	7 (1.1)	14 (1.0)	21 (1.1)
Cornea	83 (13.3)	206 (16.7)	289 (15.6)
Pthisis	25 (4.0)	58 (4.7)	83 (4.5)
Corneal scar	21 (3.4)	45 (3.7)	66 (3.6)
Anterior staphyloma	13 (2.1)	27 (2.2)	40 (2.2)
Keratoconus	3 (0.5)	15 (1.2)	18 (1.0)
Corneal dystrophy	4 (0.6)	17 (1.4)	21 (1.1)
Other corneal opacity	17 (2.7)	44 (3.6)	61 (3.3)
Lens	56 (9.0)	88 (7.1)	144 (7.8)
Cataract	35 (5.6)	45 (3.7)	80 (4.3)
Aphakia	8 (1.3)	7 (0.6)	15 (0.8)
Other lens abnormalities	13 (2.1)	37 (3.0)	50 (2.7)
Uvea	16 (2.6)	47 (3.8)	63 (3.4)
Coloboma	10 (1.6)	35 (2.8)	45 (2.4)
Aniridia	2 (0.3)	4 (0.3)	6 (0.3)
Uveitis	0 (0.0)	2 (0.2)	2 (0.1)
Other uveal abnormalities	4 (0.6)	6 (0.5)	10 (0.5)
Retina	119 (19.0)	163 (13.2)	280 (15.1)
Retinal dystrophy	71 (11.4)	112 (9.1)	183 (9.9)
Retinopathy of prematurity	21 (3.2)	12 (0.9)	31 (1.7)
Albinism	2 (0.3)	7 (0.6)	9 (0.5)
Retinoblastoma	0 (0.0)	1 (0.1)	1 (0.1)
Other retinal abnormalities	25 (4.0)	31 (2.5)	56 (3.0)
Glaucoma	39 (6.3)	41 (3.3)	80 (4.3)
Buphthalmos	32 (5.1)	30 (2.4)	62 (3.3)
Glaucoma	7 (1.1)	11 (0.8)	18 (1.0)
Optic Nerve	31 (5.0)	72 (5.8)	103 (5.6)
Optic atrophy	27 (4.3)	60 (4.9)	87 (4.70)
Optic nerve hypoplasia	2 (0.3)	7 (0.6)	9 (0.49)
Other optic nerve abnormality	2 (0.3)	5 (0.4)	7 (0.38)
OTHERS	35 (5.3)	66 (5.4)	101 (5.4)
Total	623 (100)	1231 (100)	1,854 (100)

*Others include refractive error, amblyopia, cortical blindness, idiopathic nystagmus, etc.

assessments are required before being enrolled in special education. Periodic examination of special schools would also detect students with treatable causes of visual loss who need a referral.

A comprehensive approach is required to achieve the goals of eliminating avoidable blindness in children, which requires continuous surveillance and augmentation of the current programs at the primary level. Eye care for children

needs to be an integral component of primary healthcare for children, including newborn eye screening, which would lead to earlier identification and referral. Although pediatric eye care centers are expanding in India, many are located in urban areas and are not accessible to the rural population. One pediatric eye care center for every 10 million population has been recommended by WHO,^[8] and as Maharashtra has a population of approximately 123 million, this would mean 12–13 across the state. There are approximately 6–7 such centers in the state (personal communication). All are located in urban regions and do not have direct referral linkages with primary care centers.

Marathwada, the least developed region, recorded the highest proportion of students with NPL, the highest proportion of whole globe anomalies (62.5%), and the lowest proportion with retinal blindness, including ROP (5.4%). The high proportion of whole globe anomalies could be due to consanguineous marriage, poor maternal health, and possibly environmental factors. Whole globe anomalies were less common in western Maharashtra, the most developed region, which may reflect a decline in consanguineous marriage. These findings reemphasize the fact that the pattern of childhood blindness is closely associated with levels of socioeconomic development. Regional differences were also observed in other studies,^[14] hence the strategies should vary depending on need.

In our study, several students had moderate VI or better vision, reflecting inappropriate enrolment in schools for the blind. Similar numbers have been reported from other studies too.^[14] The role of rigorous assessment before enrolment in special education cannot be emphasized more.

As per the last census, the population of the age group of 0–15 years is nearly 30 million in Maharashtra.^[35] If the estimate of the prevalence of childhood blindness (0.5/1,000 children)^[2-4] is applied to this population, then the number of children who are likely to be blind is approximately 15,000 in the state. This reflects the actual need for special education, referral to treatment, or rehabilitation programs in the state.

There are some inherent limitations to this study. Children with multiple disabilities, those from poor, remote, and rural communities are likely to be underrepresented so also preschool children. The lack of preschool children in this study means that changes in the causes that may have occurred over the last 5–6 years cannot be captured. In the present study, only 5.5% of students had an additional physical or intellectual disability, which is much lower than among SVI/BL children in high-income countries.^[36] Although this may reflect a different pattern of causes, in India, visually impaired children with other disabilities are unlikely to be accepted in schools for the blind and may be placed in schools for children with multiple disabilities. In addition, the findings in this study cannot be extrapolated reliably to the population despite providing an understanding of the pattern of childhood blindness in a particular region. It has been estimated that only 10% of children who are blind in low-resource settings receive special education.^[8] Apart from lack of provision, stigma, mistrust, skepticism, lack of awareness among parents, and distance are also likely barriers, particularly in remote and poor areas. Although the Government of India's policy promotes inclusive education, there are several challenges, which include negative

attitudes of teachers and parents, lack of trained teachers, distance, and cost.^[37]

Conclusion

In this study in Maharashtra, the major causes of SVI and blindness in students in special schools are whole globe anomalies, and nearly a third of the causes are avoidable. Blindness from ROP may be increasing suggesting a need to increase the coverage of screening. There is a need to map and strengthen accessible rehabilitation programs to help affected children lead a rewarding and independent life in the future.

Overall, health education and promotion, early screening to detect treatable causes of blindness, low vision devices to improve functional vision, and early intervention programs to rehabilitate irreversibly blind children are different ways to reduce the burden of childhood blindness. Integration of eye care into the general child healthcare programs is necessary to achieve this.

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Conflicts of interest

There are no conflicts of interest.

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