The causes of childhood blindness in South Africa

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Objectives. 1. To ascertain the causes of severe visual impairment and blindness in children in schools for the blind in South Africa. 2. To determine the major avoidable causes. 3. To determine causation by ethnic group.

Design. A cross-sectional survey, undertaken at 15 of the 16 schools for the blind in South Africa, during May - September 1996, using standard WHO methodology.

Subjects. Children less than 16 years of age on May 1996.

Results. Of 1 615 eligible children, 1 311 were examined. According to WHO categories of visual impairment, using the corrected visual acuity in the better eye, 30.4% of children were blind (< 3/60, BL), 12.6% had severe visual impairment (< 6/60 - 3/60, SVI), 42.3% were visually impaired (< 6/18 - 6/60), and 12.0% had no impairment (6/18 or better). The anatomical sites of SVI/BL in 564 children were: retina 38.5%; optic nerve 15.2%; cornea/phthisis bulbi 11.0% and glaucoma 6.7%. Aetiological categories of SVI/BL were: hereditary diseases 33.0%; intra-uterine factors 0.9%; perinatal conditions 13.1%; acquired conditions of childhood 11.5%. In 41.5% the underlying cause could not be determined. In 38.8% of children with SVI/BL the cause was avoidable, i.e. preventable or treatable. The main causes varied between ethnic groups, the major difference being the higher proportion of retinopathy of prematurity in white and Indian children.

Conclusions. The study suggests that 38.8% of causes of SVI or blindness in children in schools for the blind in South Africa are avoidable, and that specific control measures need to be targeted at different ethnic groups.

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There are estimated to be 1.5 million blind children worldwide.[1] This is far less than the estimate of 38 million for adult blindness.[2] However, it can be argued that the burden of blindness is best described in terms of years of disability; when thought of in these terms, blindness in children becomes important. The prevalence of blindness in children in European countries varies from 0.2 to 0.4/1 000 children, and in Asian countries from 0.6 to 1.1/1 000 children; in

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African countries the estimates of prevalence vary from 0.5 to 1.1/1 000 children.[3] Prevalence figures are higher in countries with lower levels of socio-economic development, and higher infant and under-5 mortality rates. There are no accurate population-based data from South Africa, a country with many different ethnic groups which have varying health indicators. Population-based studies to determine the prevalence of blindness in children need large sample sizes, and surveys that accurately describe the distribution of causes by ethnic group would need to be extremely large.

Most data on the causes of blindness in children have come from examination of children in schools for the blind, and these data, although subject to selection bias, show that the main causes of blindness in children vary from country to country and that a high proportion of causes are avoidable i.e. are preventable or treatable. Data from blind school studies undertaken in east, central and west African countries show that the commonest causes of blindness are acquired diseases of childhood, such as vitamin A deficiency and measles infection.[4-6] No data are available on the causes of blindness in children in South Africa. This information is essential for the planning of appropriate strategies for prevention of blindness. This study was undertaken to determine the major preventable and treatable causes of blindness and severe visual impairment in children in schools for the blind, and to determine whether the major causes varied according to ethnic group.

Methods

A cross-sectional survey was undertaken in schools for the blind in South Africa between 19 May and 31 August 1996. The South African National Council for the Blind provided lists of all affiliated schools for the blind. The school principals were contacted to obtain consent to perform the study. Local ophthalmologists were contacted prior to the study where possible, to explain the purpose of the survey, and to ensure follow-up for children needing spectacles or medical or surgical treatment.

All children were examined by one ophthalmologist (J O'S) using the WHO/PBL standard method and reporting form,[7] and each child was seen with his or her class teacher. Information was obtained on age, sex, place of birth and usual residence, ethnic group, medical history and maternal obstetric history from the school medical records (if available), from the teachers, or from the children. Visual acuity was measured separately in each eye with spectacle correction if worn, using a Snellen E chart to measure acuity levels of 6/18, 6/60, 3/60. For children unable to see 3/60 their ability to perceive light was assessed. Refraction was undertaken when appropriate using a streak retinoscope. External eye and fundus examinations were carried out using x 2.5 loupe, and a binocular indirect ophthalmoscope after dilation of the pupils. Causes of blindness were classified according to a descriptive classification and into aetiological categories for each eye and for the child as a whole, using the definitions given in the coding instructions that accompany the WHO form. Children were referred for further assessment, surgery or spectacles if needed. Data were entered into the database that accompanies the form.

Results

Study population. Fifteen out of 16 schools were open and consented to participate in the survey. The remaining school was closed as a result of recent changes in administration. The total number of children eligible for examination (i.e. aged 15 years or under on 1 May 1996) was 1 615 and, of these, 1 311 (81%) were examined. The majority of children in the schools were black (743, 56.7%); 338 children (25.8%) were white, 51 (3.9%) were Indian, 159 (12.1%) were coloured and in 20 (1.5%) the ethnic group could not be determined. Coloured children and those in whom the ethnic group could not be determined have been combined into one group for analysis.

Only 15 children (1.1%) were under 6 years old; 504 (38.5%) were aged 6 - 10 years, 757 (57.8%) were aged 11 - 15 years and in 35 (2.7%) the age was not known.

Categories of visual impairment. The distribution of visual loss according to the WHO categories and by ethnic group are shown in Table I. Thirty per cent of children were blind, 12.6% were severely visually impaired, 42.3% were visually impaired, and 12.0% had no impairment. The last group includes children with additional handicaps, and children with visual field loss due to retinal dystrophies.

Anatomical site of abnormality. The anatomical sites of abnormality in the 564 children with SVI/BL are shown by ethnic group in Table II. Retinal conditions were the commonest cause in each of the ethnic groups, accounting for 38.5% of cases overall. Lesions of the optic nerve, mostly optic atrophy, were the second commonest cause (15.2%), followed by corneal conditions (11.2%), of which corneal scarring and staphylomas were the commonest.

There were major differences between the ethnic groups. There was a preponderance of retinal conditions in white children (65.5%), compared with 28.3% in black children

Table I. Visual acuity by ethnic group in 1 311 children attending 15 schools for the blind in South Africa, 1996

	Black (*N* = 743)		White (*N* = 338)		Indian (*N* = 51)		Coloured (*N* = 159)		Other/NK (*N* = 20)		Total (*N* = 1 311)	
Category of visual impairment	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
≥ 6/18 (NI)	69	(5.3)	60	(4.6)	4	(0.3)	22	(1.7)	2	(0.2)	157	(12.0)
< 6/18 - 6/60 (VI)	340	(25.9)	123	(9.4)	20	(1.5)	61	(4.7)	11	(0.8)	555	(42.3)
< 6/60 - 3/60 (SVI)	91	(6.9)	46	(3.5)	10	(0.8)	17	(1.3)	1	(0.1)	165	(12.6)
< 3/60 - NPL (BL)	227	(17.3)	99	(7.6)	16	(1.2)	51	(3.9)	6	(0.5)	399	(30.4)
Could not test	16	(1.2)	10	(0.8)	1	(0.1)	8	(0.6)	0	(0.0)	35	(2.7)
Total	743	(56.7)	338	(25.8)	51	(3.9)	159	(12.1)	20	(1.5)	1 311	(100)

Table II. Anatomical site of abnormality by ethnic group in 564 children with severe visual impairment or blindness attending 15 schools for the blind in South Africa

	Black		White		Indian		Coloured/other/NK		Total	
Site	*N*	(%)	*N*	(%)	*N*	(%)	*N*	(%)	*N*	(%)
Whole globe	27	(8.5)	5	(3.4)	1	(3.8)	3	(4.0)	36	(6.4)
Microphthalmos	14		3		1		1		19	
Anophthalmos	7		2		0		2		11	
Other	6		0		0		0		6	
Cornea	47	(14.8)	5	(3.4)	3	(11.6)	8	(10.7)	63	(11.2)
Scar/staphyloma	22		2		1		3		28	
Phthisis bulbi	15		2		1		1		19	
Other opacity	10		1		1		4		16	
Lens	18	(5.7)	2	(1.4)	0	0	1	(1.3)	21	(3.7)
Cataract	14		0		0		1		15	
Other	4		2		0		0		6	
Uvea	20	(6.3)	4	(2.8)	3	(11.6)	6	(8.0)	33	(5.9)
Coloboma	10		1		1		2		14	
Uveitis	5		0		1		3		9	
Aniridia	5		3		1		1		10	
Retina	90	(28.3)	95	(65.5)	8	(30.8)	24	(32.0)	217	(38.5)
Dystrophy	33		44		0		5		82	
ROP	4		41		8		7		60	
Albinism	29		2		0		1		32	
Other	24		8		0		11		43	
Optic nerve	41	(12.9)	22	(15.2)	5	(19.2)	18	(24.0)	86	(15.2)
Optic atrophy	35		11		4		16		66	
Hypoplasia	6		6		0		1		13	
Other	0		5		1		1		7	
Glaucoma	31	(9.7)	4	(2.8)	1	(3.8)	2	(2.7)	38	(6.7)
Buphthalmos	14		2		1		0		17	
Glaucoma	17		2		0		2		21	
Other	44	(13.8)	8	(5.5)	5	(19.2)	13	(17.3)	70	(12.4)
Amblyopia	28		5		2		10		45	
Cortical	6		2		1		2		11	
Other	10		1		2		1		14	
Total	318	(100)	145	(100)	26	(100)	75	(100)	564	(100)

and 30.8% in Indian children. Black children had a higher proportion of SVI/BL due to glaucoma (9.7%) than the other 3 ethnic groups (white: 2.8%, Indian: 3.8% and other: 2.7%). Corneal scarring accounted for 14.8% of SVI/BL in black children, 11.6% in Indian, 10.7% in coloured and only 3.4% in white children. None of the white or Indian children had an unoperated cataract, whereas 14 black children needed cataract surgery.

Aetiological categories. The aetiological categories in the 564 children with SVI/BL are shown by ethnic group in Table III. In 41.5% of children the underlying cause could not be determined. Sixty-two of these children (10.6%) had phthisical or disorganised eyes where the pathological processes could not be determined. Hereditary diseases accounted for 33% of SVI/BL, intra-uterine events for 0.9%, perinatal conditions for 13.1% and childhood factors for 11.5%. Black children had the lowest proportion of SVI/BL caused by perinatal conditions, with only 4 children being blind as a result of retinopathy of prematurity (ROP) (1.25%). This is in sharp contrast to the Indian and white ethnic groups where ROP accounted for 30.8% and 28.3%, respectively. All the children who were SVI/BL from vitamin A deficiency and/or measles infection were in the black or coloured ethnic groups, and most of the children with ophthalmia neonatorum were black.

Avoidable causes. Conditions amenable to primary prevention and those that are treatable are shown in Table IV. Overall, 38.8% of children had SVI/BL caused by conditions that could have been prevented (27.5%) or treated (11.4%).

Discussion

Blind children in special education. Two blindness prevalence surveys have been undertaken in South Africa, one in northern KwaZulu and the other in the Northern Province.[8,9] In both surveys the sample size was not large enough to give accurate figures for the number of blind children, and in both the authors estimate the prevalence of blindness to be 0.5/1 000 children. No mention is made of ethnic differences in prevalence. Blindness prevalence data from surveys in other countries suggest a correlation between certain health indicators (e.g. under-5 mortality

Table III. Aetiological categories by ethnic group in 564 children with severe visual impairment or blindness attending 15 schools for the blind in South Africa

Site	Black *N*	Black (%)	White *N*	White (%)	Indian *N*	Indian (%)	Coloured/other/NK *N*	Coloured/other/NK (%)	Total *N*	Total (%)
Hereditary	97	30.5	63	43.4	6	23.1	20	26.7	186	33.0
Autosomal dominant	26		14		2		11		53	
Autosomal recessive	36		28		0		4		68	
Cannot specify	34		17		4		5		60	
Other	1		4		0		0		5	
Intra-uterine	2	0.6	3	2.1	0	0	0	0	5	0.9
Rubella	2		0		0		0		2	
Toxoplasmosis	0		0		0		0		0	
Other	0		3		0		0		3	
Perinatal	14	4.4	43	29.7	9	34.6	8	10.7	74	13.1
ROP	4		41		8		7		60	
Ophthalmia neonatorum	5		0		1		0		6	
Other	5		2		0		1		8	
Childhood	39	12.3	7	4.8	2	7.7	17	22.6	65	11.5
VAD/measles	16		0		0		3		19	
Trauma	4		2		0		2		8	
Other	19		5		2		12		38	
Unknown	166	52.2	29	20.0	9	34.6	30	40.0	234	41.5
Cataract	31		0		1		4		36	
Glaucoma	26		1		1		0		28	
Retinoblastoma	11		2		0		4		17	
Congenital abnormality	54		22		5		10		91	
Other	44		4		2		12		62	
Total	318	100	145	100	26	100	75	100	564	100

VAD = vitamin A deficiency.

Table IV. Interventions required for avoidable causes of severe visual impairment and blindness by ethnic group (%)

Intervention required	Black	White	Indian	Coloured/other	Total
Primary health care, i.e. measles/rubella immunisation; ocular prophylaxis of the newborn; control of vitamin A deficiency	23 (7.2%)	0 (0%)	1 (3.8%)	3 (6.0%)	27 (4.8%)
Other preventive measures, i.e. genetic counselling services for autosomal dominant conditions; good antenatal care; intensive neonatal care; for trauma and other teratogens	38 (12.0%)	59 (40.7%)	10 (38.5%)	21 (28.0%)	128 (22.7%)
Surgical and medical treatment, i.e. for cataract; glaucoma and uveitis	57 (17.9%)	1 (0.7%)	2 (7.7%)	4 (5.3%)	64 (11.4%)
Total avoidable	118 (37.1%)	60 (41.4%)	13 (50.0%)	28 (37.2%)	219 (38.8%)

rates and infant mortality rates) and prevalence of blindness in children.[3] Infant mortality rates for the different ethnic groups in South Africa are as follows: 54.3/1 000 live births in blacks; 36.3/1 000 live births in coloureds; 9.9/1 000 live births in Indians and 7.3/1 000 live births in whites.[10] The population of children aged 0 - 15 years in South Africa is approximately 13.7 million (11.2 million blacks (81.5%), 1.1 million coloureds (8.04%), 0.3 million Indians (2.2%) and 1.1 million whites (8.21%)).[11] Using these figures and the number of SVI/BL children in blind schools one can estimate the minimum prevalence of blindness in school-age children (5 - 14 years) by ethnic group (Table V). When the actual figures are compared with expected prevalence of SVI/BL it would appear that only 10.1% of blind children are in schools for the blind, a figure consistent with other developing countries. Approximately 94% of the estimated number of blind white children are in special education compared with only 6% of black children. This may reflect variable accessibility to special education, or lack of awareness or willingness on the part of parents to send their blind children to special schools. The varying admission rates also mean that there is likely to be more selection bias in data on the causes of blindness in black children than in data on white children.

Table V. Estimates of the number of blind children (aged 5 - 14 years) in South Africa by ethnic group and the approximate percentage in blind school education

Ethnic group	Population aged 5 - 14 years (P)	Number of SVI/BL in special education (n)	Minimum prev. of SVI/BL (/1 000 children (n/P))	IMR (/1 000)	Estimate of blindness prevalence (/1 000 children)	Estimate of actual No. of SVI/BL children, 5 - 14 years (N)	Approx. % of SVI/BL in special education (n/N)
Black	7 114 099	318	0.04	54.3	0.7 ± 0.2	4 980 ± 1 423	6.4
Coloured	727 647	75	0.10	36.3	0.5 ± 0.2	364 ± 146	20.6
Indian	202 619	26	0.13	9.9	0.3 ± 0.1	61 ± 20	42.8
White	772 779	145	0.19	7.3	0.2 ± 0.1	155 ± 77	93.8
Total	8 817 144	564	0.06		0.35 – 0.6	5 560 ± 1 666	10.1

Comparison with other African blind school studies. Data from blind school studies undertaken in three west African countries, three east African countries and Zimbabwe[4-6] have shown that 29%, 27% and 67% of visual loss, respectively, was caused by corneal scarring attributed to vitamin A deficiency, measles infection and/or the use of harmful traditional eye medicines. In this study the proportion of SVI/BL caused by these acquired conditions of childhood was much lower. This may be due to selection bias, as it has already been demonstrated that fewer than 1 in 10 black and coloured children with SVI/BL are in blind school education, but is also probably indicative of the higher level of socio-economic development in South Africa than in the other countries, with better health care provision and higher measles immunisation coverage rates.

The other major difference in this study is the finding that 10.6% of children were blind as a result of ROP. In all the other studies from African countries no children were blind because of this. Again, this reflects the higher level of health care in South Africa, with provision of intensive neonatal care services for preterm and low-birth-weight babies.

Variation in the major causes by ethnic group. The major ethnic difference in causes is the high proportion of SVI/BL due to ROP in Indian and white children, compared with other ethnic groups. This could be due to lower rates of prematurity and low birth weight in blacks and coloureds, or could be due to a lower risk of ROP in black and coloured preterm babies. However, the most likely explanation is that the findings reflect better accessibility to intensive neonatal care for preterm babies from white and Indian communities.

Most of the children in schools for the blind with oculocutaneous albinism were black, which again could reflect varying incidence by ethnic group, but could also reflect social and cultural attitudes, as this condition is more evident among blacks.

The proportion of black children with SVI/BL from conditions amenable to surgical management and medical treatment was higher than in other ethnic groups, and 14 black children had unoperated cataracts.

Avoidable causes. Overall 4.8% of children had conditions amenable to primary preventive measures, most of whom were black. Almost a quarter of children (22.7%) had conditions that could be prevented by sophisticated health care, such as genetic counselling services and intensive neonatal care, while 11.4% had conditions needing tertiary eye care.

Conclusions

1. More than 50% of the children in blind school education in South Africa have a best corrected acuity of 6/60 or better. There is a need for dialogue with teachers and parents to see if some of these children could be integrated into normal schooling.

2. Corneal scarring is still a significant cause of preventable blindness in the black and coloured communities, with the combination of measles and vitamin A deficiency being the main pathway.

3. ROP is an emerging and preventable cause of blindness in the white and Indian communities.

4. Cataract in childhood and congenital glaucoma are potentially treatable causes of blindness, particularly in the black population.

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