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Inter-regional trends in causes of childhood blindness and low vision in Ghana

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Background: Inter-regional trends of visual loss in most developing countries remain largely unknown. We compared the causes of childhood blindness among children attending blind schools in the northern (one school) and southern (two schools) regions of Ghana and assessed their need for spectacles and low-vision devices.

Methods: Using a standardised methodology, children were examined by an ophthalmologist and optometrists in each location. Causes of visual loss were classified anatomically and by time of onset, and avoidable causes identified. Children identified with functional low vision were assessed and provided with low-vision devices.

Results: A total of 252 children under 16 years of age were examined in the schools. The overall prevalence of total blindness was 73 (29.0 per cent), with similar proportions (p = 0.87) in the north (29 [28.4 per cent]) and south (44 [29.3 per cent]); 92 (36.5 per cent) had functional low vision. Two children improved with spectacles and 35 benefited from low-vision devices. Corneal scarring was significantly (p = 0.045) more prevalent in southern Ghana (n = 150) than in the north (n = 102), responsible for visual loss in 36 (24.0 per cent, 95% CI 17.2–30.8 per cent) and 14 (13.7 per cent, 95% CI 7.0–20.4 per cent) cases, respectively. No significant difference (p = 0.321) was observed in the prevalence of cataract between northern (28: 27.5 per cent, 95% CI 18.3–36.2 per cent) and southern Ghana (33: 22.0 per cent, 95% CI 15.4–28.6 per cent). Over 87 per cent of children had 'avoidable' causes of visual loss, with a higher proportion being treatable (124: 49.2 per cent) than preventable (96: 38 per cent).

Conclusion: Cataract was the major cause of visual loss in the overall population. The south had a higher proportion of corneal scarring and late-onset blindness compared with the north. More than one-third of blindness in blind schools in Ghana could have been prevented by primary care interventions and nearly half could have been treated surgically to prevent visual loss. Two in five children in blind schools in Ghana could benefit from optical intervention.

Key words: blindness, childhood, low vision, visual impairment

The World Health Organization (WHO) Program for Prevention of Blindness[1] and the WHO Prevention of Blindness and Low Vision Eye Examination Record for Children with blindness and low vision (WHO/PBL ECRB)[2] defined blindness as presenting visual acuity of worse than 3/60 in the better eye with best possible correction, and 'functional' low vision (FLV) as the ability to navigate independently around two chairs by vision alone with a presenting visual acuity of worse than 6/18 to light perception (LP) in the better eye with best possible correction. In this article, the term 'visual impairment' refers to presenting visual acuity in the better-seeing eye of worse than 6/18 but better than 3/60.[1,2] To allow comparison of data across studies, the WHO/PBL ECRB[2] defines a child as under 16 years of age.

The revised 2010 global blindness estimates show a trend of reduction of childhood blindness to 1.26 million compared with the previous estimates in 1999 of 1.4 million.[3] However, in sub-Saharan Africa, the number of blind children has increased by 31 per cent to 419,000.[4] Blind children in this region are likely to have high mortality, but those who survive contribute a disproportionate number of blind years of disability[4] which may impact on their psychological, educational and economic development.[5,6]

It is estimated that childhood blindness accounts for five to 10 per cent of the national burden of blindness in Ghana, affecting about 0.9 per 1,000 children.[7] The situation is similar in many sub-Saharan countries of Africa because of the inadequacy of facilities and medical personnel to treat and prevent the avoidable causes. In Ghana, although significant efforts have been made in the elimination of avoidable blindness through public health measures,[8] no extended study which enrolled a large set of a sample representative of the entire country has been undertaken to monitor the changing patterns over time. The majority of studies on childhood blindness in the

country have focused on one blind school within a region and did not simultaneously examine inter-regional variations.[7,9] Such information is required for prioritising blindness prevention programs to provide more precise interventions. The most recent blind school survey was a retrospective study in the Wa School for the Blind in northern Ghana,[10] and portrayed corneal scarring as the primary cause of childhood blindness.

The Ghana Statistical Service 2005–2017 report[11] indicates there is a distinct north–south disparity in socio-economic development wherein the northern regions are significantly less-developed, with a relatively high poverty rate (70.7 per cent), low rate of urbanisation (15.1–27 per cent) and a low adult literacy of 24.4 per cent. These indices are two to three times better in the south. These disparities have huge implications for health. For instance, the under-five mortality rate in the north is 2.5 times higher than in the south.[12] The disparity in eye health may be exacerbated by the fact that 75 per cent of eye-care professionals in Ghana are in southern Ghana, resulting in service gaps in the north.[13,14] There are only four ophthalmologists and 13 optometrists[15] serving the northern parts of the country with a population of 5.1 million whereas in the south there are 88 ophthalmologists and 357 registered optometrists serving approximately 23 million people.[15,16] This suggests that the ophthalmologist- and optometrist-to-population ratio in the north is 1:1,100,000 and 1:392,000 respectively.[15] These proportions are three times higher than the national proportion of 1:311,080 for ophthalmologist/population and five times higher (1:76,508) for optometrist/population. Paediatric eye clinics and paediatric ophthalmologists are non-existent in the north.[17] In general, access to eye care, optical and low-vision services are restricted in northern Ghana, due to cost or inadequacy of eye-care workers.[7] Therefore the unequal access to eye care may translate into variations in the causes and prevalence of childhood eye conditions in different parts of the country.

Despite there being some blind school-based data on causes of childhood blindness in Ghana, there are no data on inter-regional trends and to date, data from only one blind school survey in Ghana have been analysed using the FLV definition. These data are urgently needed for rational planning of blindness control programs for children. The aim of the present study was to examine inter-regional variations in causes of visual loss among children under 16 years of age attending three state-owned schools for the blind in northern and southern parts of the country. Another aim was to assess the requirements of individual children for spectacles, and low-vision devices.

Methods

Setting/participants

A prospective, cross-sectional study was carried out on children below 16 years of age in all three state-owned schools for the blind which offer specialised first cycle education for children with visual loss in Ghana. These schools are the Akropong (the oldest school for the blind in Ghana)[18] and Cape Coast Schools for the blind in southern Ghana, and the Wa School for the Blind in northern Ghana, which serves the three northern regions.

Recruitment

Ethics approval was obtained from the Institutional Review Board of the University of Cape Coast, Ghana, and the study procedures adhered to the Declaration of Helsinki for research involving human subjects. In addition, permission to conduct the study was received from the Directorates of Health and of Education, both at district and regional levels where the blind schools are located. The schools were individually visited by the research team to explain the purpose of the study to the school administration. During the visit, registration data of the students were obtained from the school registers, and a convenient examination date at each school was scheduled. All students under the age of 16 years were invited to take part in the study.

Signed informed consent was obtained from the school authorities and parents or legal guardians at the time of examination, after explaining the objectives of the study and the details regarding the eye examination. To ensure confidentiality patient's personal information was secured on a dedicated password-protected hard drive which was accessible only to the lead investigator.

Examination

Examinations were performed on the school premises, between February and May 2018, by a team comprising an ophthalmologist, optometrists, teachers and caregivers, and an educationist with expertise in special education. The ophthalmologist and optometrists undertook the eye examinations. History of visual loss, family history, previous surgery and the presence of additional disability (for example, hearing loss, epilepsy) were recorded by the teachers or caregivers, as available. The educationist worked in partnership with the rest of the team, to ensure that children comply with the instructions. Age at onset of visual loss (the age at which the child becomes blind) was determined from doctor's referral records or information from caregivers with knowledge of the child's past medical history.

The team ophthalmologist evaluated the anterior segments of the eye with a penlight and a magnifying loupe and where necessary performed a hand-held slitlamp biomicroscopy (model S150, 5X). The posterior segment was examined using a direct and/or binocular indirect ophthalmoscope (GR-BIO2100, Welch Allyn) where appropriate with the pupils dilated. Intra-ocular pressure was measured using a portable Rebound Tonometer (ICARE, MCE-SW-500) when indicated. All data were recorded according to the WHO/PBL ECRB record coding instructions.[2] The ophthalmologist assigned major anatomical site and cause of abnormality for each eye, using criteria given in the coding instructions. The anatomical classification of causes of visual loss defines that part of the eye which has been damaged leading to visual loss (for example, whole globe, cornea, lens, retina) whereas the anatomical cause is the primary cause of the injury directly contributing most to visual loss (for example, glaucoma, corneal scarring, cataract).[2] If the causes were different in the two eyes, the most preventable or treatable cause was selected. The time of onset of visual loss refers to the time of onset of the condition leading to blindness and this was divided into five categories as follows: hereditary, intrauterine, perinatal, childhood and unknown.[2] Avoidable causes of visual loss were determined as preventable and treatable. The preventable conditions are those amenable to primary intervention, for example, by measles and rubella immunisation, and treatable conditions are those in which visual loss can be prevented by early diagnosis and prompt treatment, for example, cataract and glaucoma.[2] Children found with treatable conditions were promptly referred to centres providing surgical intervention and were followed up.

Refraction

Distance visual acuity was taken for each eye at three and six metres in well-lit classrooms, using the Snellen illiterate E (Precision Vision,

Characteristics	North (n = 102)		South (n = 150)		p	Total (n = 252)	
	n	%	n	%		n	%
Sex					0.975		
Male	58	56.9	85	56.7		143	56.7
Female	48	47.1	65	43.3		109	43.3
Age of onset of visual loss[†]					0.007		
Since birth	49	48	65	43.3		114	45.2
First year of life	5	4.9	12	8.0		17	6.7
1–15 years	27	26.5	61	40.7		88	34.5
Unknown	21	20.6	12	8		33	12.9
Previous surgery					0.543		
None	78	76.5	114	76		192	76.2
Glaucoma	0	0	2	1.3		2	0.8
Cataract	3	2.9	3	2.0		6	2.4
Enucleation	1	0.9	0	0		1	0.4
Other	0	0	4	2.7		4	1.6
Unknown	20	19.6	27	18		47	18.7
Additional disability					0.475		
None	99	97.1	144	96		243	96.4
Hearing loss	0	0	2	1.3		2	0.8
Learning disability	3	2.9	2	1.3		5	1.98
Physical disability	0	0	1	0.7		1	0.4
Epilepsy	0	0	1	0.7			0.4

p-values are derived from the comparison of north and south.

[†]Age at which children become blind; age of onset is categorised as 'since birth' if child was born blind, if blindness occurred before the child's first birthday it is categorised as 'first year of life'.

Table 1. Sex, age of onset of visual loss, previous surgery and additional disability of 252 children attending schools for the blind in Ghana

		Better eye	Before refraction		After refraction	
			n	%	n	%
WHO ICD-10[†] category of visual impairment	No impairment	≥ 6/18	0	0	2	0.8
	Low vision / Moderate VI	< 6/18–6/60	9	3.6	7	2.8
	Severe VI	< 6/60–3/60	11	4.4	11	4.4
	Blind	< 3/60 to LP	159	63.1	159	63.1
	Total blindness	NLP	73	29.0	73	29.0
		Total	252	100	252	100
Functional low vision category	No impairment	≥ 6/18	0	0	2	0.8
	Functional low vision status	< 6/18 to LP, with functional vision	85	33.7	92	36.5
		< 6/18 to LP, no functional vision	94	37.3	85	33.7
	Total blindness	NLP in both eyes	73	29.0	73	29.0
		Total	252	100	252	100

LP: light perception, NLP: no perception of light, VI: visual impairment.

Categories in 252 children aged under 16 years attending schools for the blind in Ghana.

[†]WHO ICD-10: World Health Organization International Statistical Classification of Disease and Related Health Problems.[31]

Table 2. WHO ICD-10 categories of visual impairment (habitual and after refraction) and functional low vision

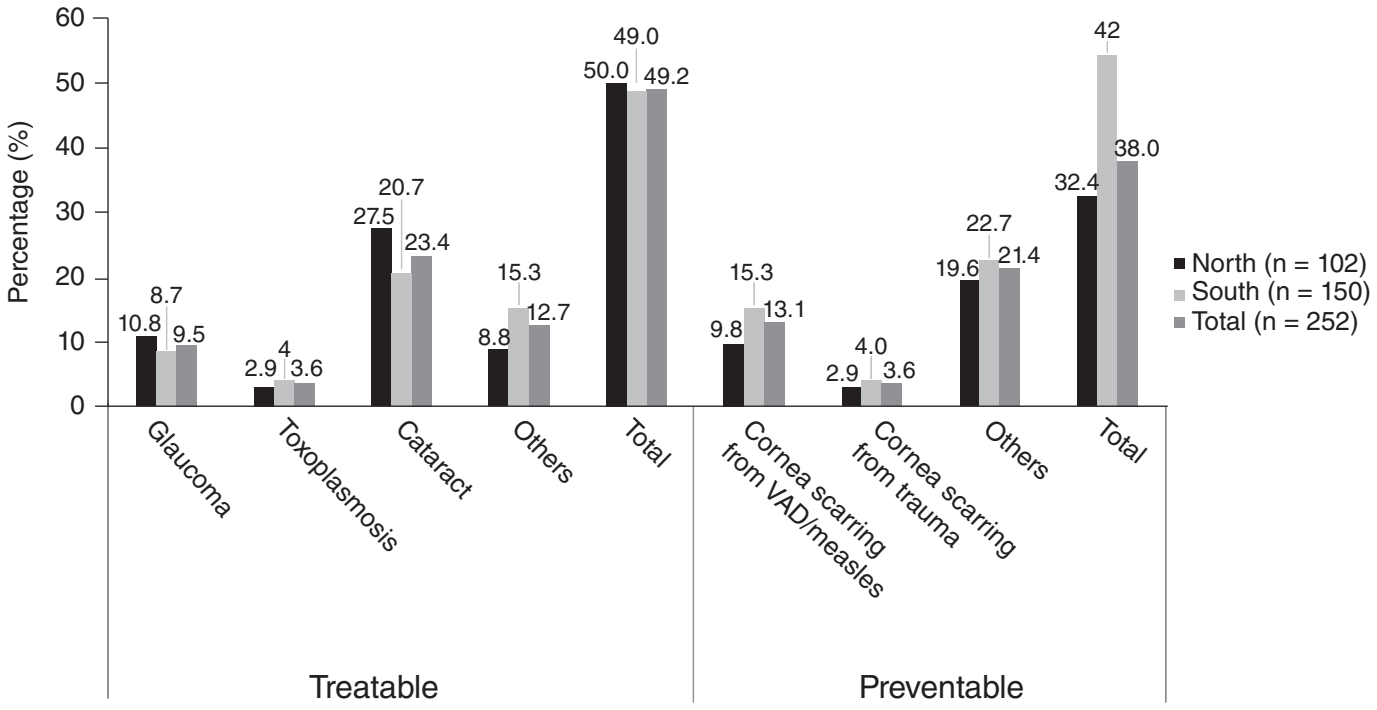

Figure 1. Avoidable causes of visual loss in 252 children attending schools for the blind in Ghana. Avoidable causes of visual loss are those conditions that can be prevented by primary intervention or by prompt treatment.

La Salle, IL, USA) chart. Pinhole testing was performed with multiple pinholes. Routine refraction was performed after instillation of cyclopentolate 1% eye drop. Visual loss was classified according to the WHO categories of visual impairment[19] and the revised working definition of low vision (Table 2). Near visual acuity was assessed at a near range of 40 cm using the Tumbling 'E' Near Point Vision Acuity Chart (Precision Vision) and recorded in N notation. N10 or better was chosen as the target near acuity during low-vision assessment as this is equivalent to the print size used in books for primary level education in Ghana.

Low-vision assessment

A child was appropriate for low-vision assessment if they were identified as having functional vision which is the ability to navigate without assistance between chairs set one metre apart in a well-lit room with a vision of < 6/18 to LP (WHO/PBL ERCB).[2] Children with functional vision underwent low-vision assessment and appropriate low-vision devices provided. The students and teachers were counselled on the use of the devices and the teachers were advised to encourage the recipients to use the devices.

Data management and analysis

Data forms were received by the lead investigator at the study sites and entered into Microsoft Excel on a password-secured computer. Analyses were done using the Statistical Package for Social Sciences for Windows (version 16.0; SPSS Inc, Chicago, IL, USA) with confidence intervals (CIs) set at 95% and statistical significance drawn at an alpha level of 0.05 (two-tailed). Prevalence of visual impairment and blindness were estimated from data on presenting visual acuity and in some cases after refraction. To explore inter-regional trends in causes of visual loss, the data was classified into two regional groups, north (Wa School for the Blind) and south (Akropong, and Cape Coast School for the Blind). Frequencies were generated for demographic, health and vision categories in each group. The chi-squared (χ^2) test was used to assess differences in the proportion of cases between the two groups.

Results

A total of 252 students between the ages of 5–15 years were examined in the three schools for the blind across three regions in Ghana; 118 from Akropong in the south, 32 from Cape Coast also in the south, and 102 from Wa in the north, representing 91, 87 and 89 per cent of children within that age group in the respective schools. The rest (30 students) did not participate because they were absent from the schools at the time of examination. The mean age of the participating students was 12.24 (SD ±2.73) years; 143 (56.7 per cent) were male and 109 (43.3 per cent) female. The majority of the students had no additional disability apart from visual loss (243: 96.4 per cent). Additional disability was mainly learning disability in five students (Table 1).

Visual acuity

Table 2 presents the distribution of presenting, best-corrected visual acuity and functional vision. Of the 252 students examined, 243 (96.5 per cent) were blind (< 3/60–no light perception [NLP]) or severely visually impaired (< 6/60–3/60). The overall prevalence of total blindness (NLP) was 73 (29.0 per cent), ranging from 29 (28.4 per cent) in the north to 44 (29.3 per cent) in the south (p = 0.87); 92 (36.5 per cent) had functional low vision (< 6/18 to LP and independent mobility).

Anatomical site	Causes	North (n = 102)			South (n = 150)				Total (n = 252)		
		n	%	95% CI	n	%	95% CI	p	n	%	95% CI
Whole globe	Phthisis	3	2.9	–0.4–6.2	5	3.3	0.4–6.2	†	8	3.2	1.0–5.4
	Anaphthalmos	3	2.9	–0.4–6.2	3	2	–0.2–4.2	†	6	2.4	0.5–4.3
	Microphthalmos	8	7.8	2.6–13.0	5	3.3	0.4–6.2	0.112	13	5.2	2.5–7.9
	Buphthalmos	0	0	–	4	2.7	0.1–5.3	†	4	1.6	0.1–3.1
	Glaucoma	11	10.8	4.8–16.8	14	9.3	4.7–13.9	**0.705**	25	9.9	6.2–13.6
	Removed	1	1	–0.9–2.9	1	0.7	–0.6–2.0	†	2	0.8	–0.3–1.9
	Disorganised	1	1	–0.9–2.9	1	0.7	–0.6–2.0	†	2	0.8	–0.3–1.9
	Total	27	26.5	17.9–35.1	33	22	15.4–28.6	0.413	60	23.8	18.5–29.1
Cornea lesions	Staphyloma	2	2	–0.7–4.7	3	2	–0.2–4.2		5	2	0.3–3.7
	Scarring	14	13.7	7.0–20.4	36	24	17.2–30.8	0.045	50	19.8	14.9–24.7
	Keratoconus	1	1	–0.9–2.9	1	0.7	–0.6–2.0	†	2	0.8	–0.3–1.9
	Dystrophy	7	6.9	2.0–11.8	7	4.7	1.3–8.1	0.455	14	5.6	2.8–8.4
	Total	24	23.5	15.3–31.7	47	31.3	23.9–38.7	0.176	71	28.2	22.6–33.8
Lesions of the lens	Cataract	28	27.5	18.8–36.2	33	22	15.4–28.6	0.321	61	24.2	18.9–29.5
	Aphakia	1	1	–0.9–2.9	3	2	–0.2–4.2	†	4	1.6	0.1–3.1
	Other	2	2	–0.7–4.7	8	5.3	1.7–8.9	†	10	4	1.6–6.4
	Total	31	30.4	21.5–39.3	44	29.3	22.0–36.6	0.857	75	29.8	24.2–35.4
Retina lesions	Dystrophy	4	3.9	0.2–7.7	5	3.3	0.4–6.2	†	9	3.6	1.3–5.9
	Albinism	1	1	–0.9–2.9	0	0	–	†	1	0.4	–0.4–1.2
	ROP	0	0	–	0	0	–	†	0	0	–
	Retinoblastoma	0	0	–	1	0.7	–0.6–2.0	†	1	0.4	–0.4–1.2
	Other	3	2.9	–0.4–6.2	10	6.7	2.7–10.7	†	13	5.2	2.5–7.9
	Total	8	7.8	2.6–13.0	16	10.7	5.8–15.6	0.454	24	9.5	5.9–13.1
Uveal disorders	Aniridia	0	0	–	0	0	–	†	0	0	
	Uveitis	1	1	–0.9–2.9	1	0.7	–0.6–2.0	†	2	0.8	–0.3–1.9
	Total	1	1	–0.9–2.9	1	0.7	–0.6–2.0	†	2	0.8	–0.3–1.9
Optic nerve	Optic atrophy	0	0	–	3	2	–0.2–4.2	–	3	1.2	–0.1–2.5
Normal globe	Refractive error	1	1	–0.9–2.9	0	0	–	†	1	0.4	–0.4–1.2
	Amblyopia	0	0	–	3	2	–0.2–4.2	†	3	1.2	–0.1–2.5
	Cortical blindness	7	6.9	2.0–11.8	3	2	–0.2–4.2	†	10	4	1.6–6.4
	Idiopathic nystagmus	3	2.9	–0.4–6.2	1	0.7	–0.6–2.0	†	4	1.6	0.1–3.1
	Total	11	10.8	4.8–16.8	6	4.7	0.9–7.1	0.035	17	6.7	3.6–9.8

ROP: retinopathy of prematurity.

p-values are derived from a comparison of north and south.

†Statistics were not computed due to some cells having insufficient data counts.

Table 3. Causes of severe visual impairment and blindness categorised by major anatomical site of abnormality leading to visual loss in 252 children attending schools for the blind in Ghana

Anatomical sites and causes of visual loss

The anatomical sites and causes of visual loss are shown in Table 3. Of 252 children examined in all locations, the major anatomical sites of visual loss were the lens in 75 (29.8 per cent; 95% CI 24.2–35.4 per cent) cases, cornea in 71 (28.2 per cent; 95% CI 22.6–33.8 per cent), whole globe in 60 (23.8 per cent; 95% CI 18.5–29.1 per cent) and retina in 24 (9.5 per cent; 95% CI 5.9–13.1 per cent). Cataract (61: 24.2 per cent), corneal scarring (50: 20 per cent), and glaucoma/buphthalmos (29: 11.5 per cent) were the most common causes of visual loss in the anatomical classification.

Time of onset of visual loss

Data on causes of visual loss by time of onset are presented in Table 4. The time of onset of visual loss could not be determined in the majority of cases. In cases where the time of onset could be determined (Table 4), childhood factors were the most common cause of visual loss responsible for 50 (19.8 per cent; 95% CI 14.9–24.7 per cent) cases, followed by intrauterine factors in 16 (6.3 per cent; 95% CI 3.3–6.3 per cent) cases, with toxoplasmosis accounting for the majority (nine: 3.6 per cent). Visual loss attributable to hereditary factors was identified in four (1.6 per cent; 95% CI 0.1–3.2 per cent) cases.

Time of onset‡	Causes	North (n = 102) n	%	South (n = 150) n	%	p	Total (n = 252) n	%
Hereditary disease	Retinitis pigmentosa	1	1	2	1.3	†	3	1.2
	Albinism	1	1	0	0	†	1	0.4
Total		2	2	2	1.3	0.696	4	1.6
Intrauterine factors	Rubella	2	2	5	3.3	†	**7**	2.8
	Toxoplasmosis	3	2.9	6	4	†	9	3.6
Total		5	4.9	11	7.3	0.437	16	6.3
Perinatal factors	Cortical	8	7.8	2	1.3	†	10	4
	ROP	0	0	0	0	†	0	0
	Ophthalmia neonatorum	0	0	1	0.7	†	1	0.4
	Other	2	2	3	2	†	5	2
Total		10	9.8	6	4	0.064	16	6.3
Childhood factors	VAD	5	4.9	12	8	0.336	17	6.7
	Measles	5	4.9	11	7.3	0.437	16	6.4
	Trauma	3	3	6	4	†	9	3.6
	Harmful eye practices§	1	1	7	4.7	†	8	3.2
Total		14	13.7	36	24	0.045	50	19.8
Unclassified	Cataract	25	24.5	26	173	0.164	51	20.2
	Glaucoma/buphthalmos	11	10.8	14	9.3	0.705	15	6
	Retinoblastoma	0	0	1	0.7	†	1	0.4
	Abnormality since birth	35	34.3	54	36	0.783	89	35.3
Total		71	69.6	95	63.3	0.302	166	65.9

ROP: retinopathy of prematurity, VAD: vitamin A deficiency.

p-values are derived from comparison of north and south.

†Statistics were not computed due to cells having insufficient data count.

‡This refers to the time of onset of the condition leading to blindness.[2]

§These are traditional practices that may cause ocular morbidity, for example, instilling breast milk, seawater, herb extracts, urine, and so on, into the eye.

Table 4. Causes of visual loss categorised by time of onset of the condition leading to blindness in 252 children attending schools for the blind in Ghana

Avoidable causes of visual loss

Figure 1 shows the preventable and treatable conditions causing visual loss among the children. Over 220 (87 per cent) children had potentially 'avoidable' causes of visual loss, with a higher proportion being treatable (124: 49.2 per cent) than preventable (96: 38 per cent). In the treatable group, cataract (59 cases) and glaucoma (24 cases), were the most prevalent causes of visual loss. Of the 59 treatable cataract cases, 55 had un-operated cataract, four were bilaterally aphakic following cataract surgery but the type of procedure could not be determined. Of the 24 glaucoma cases, only two (all from southern Ghana) had undergone drainage procedures. In the preventable group corneal scarring from vitamin A deficiency/measles (33 cases) was more prevalent.

Inter-regional trends

In Table 1, age of onset of blindness differed significantly by region (p = 0.007) and a higher proportion was blind at age 1–15 years in the south (χ^2 (1) = 5.58, p = 0.02) than in the north; no differences were observed in the other age brackets. In Table 3, the prevalence of cornea scarring was significantly higher (χ^2 (1) = 4.03, p = 0.045) in the south (36: 24 per cent) than in the north (14: 13.7 per cent). The proportion of cases of visual loss from lesions of the lens in the north (31: 30.4 per cent) and in the south (44: 29.3 per cent) was not significantly different (χ^2 (1) = 0.033, p = 0.857). There was no significant difference (χ^2 (1) = 0.983, p = 0.321) in prevalence of cataract in the north (28: 27.5 per cent) and south (33: 22 per cent). Retinal lesions (for example, retinoblastoma, retinitis pigmentosa, retinitis of prematurity) were rare, and the proportions were not significantly different (χ^2 (1) = 0.562, p = 0.45) in the north (eight: 7.8 per cent) and south (16: 19.8 per cent). Time of onset of visual loss could not be determined in 166 (65.9 per cent; 95% CI 60.1–71.8 per cent) cases, and the proportions were not significantly different (χ^2 (1) = 1.063, p = 0.30) in the north (71: 69.6 per cent) and south (95: 63.3 per cent).

Requirements for surgical intervention

Figure 2 presents information on the type of intervention given to the children examined. For 73 (29 per cent) students, no intervention was required as they were irreversibly blind (NPL). Among the rest, surgical intervention, mostly cataract surgery and corneal transplantation, was recommended in 12 students.

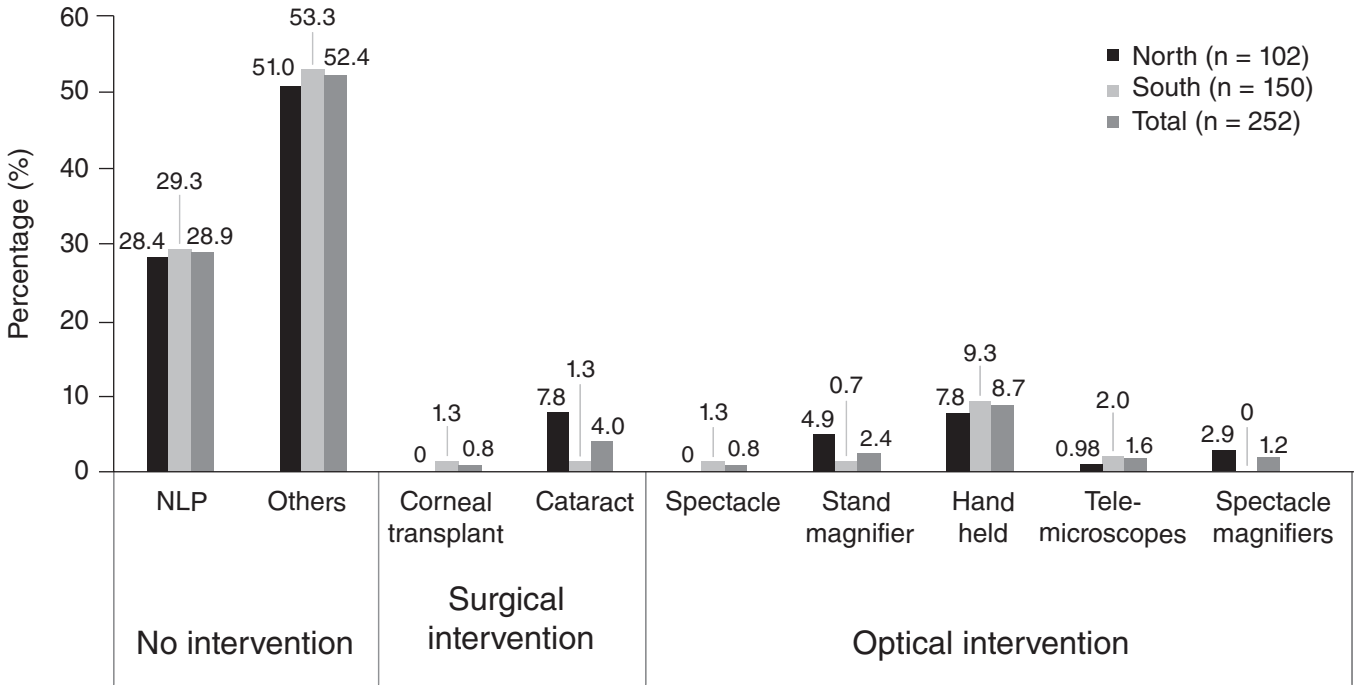

Figure 2. Interventions provided for 252 children attending schools for the blind in Ghana. NLP: no light perception.

Requirement for spectacles and low-vision devices

No child had spectacles or a low-vision device prior to the study. Assistive devices used in the schools were mainly Braille and mobility devices. Two students were prescribed spectacles and advised to change to regular education schools. Assessment for low-vision devices was carried out for 89 students as one student was lost to follow-up due to scheduling constraints; 35 (13.9 per cent) were able to read N10, and were provided with the appropriate low-vision aids. Twenty-two hand-held magnifiers, six stand magnifiers, four spectacle-mounted telemicroscopes and three spectacle magnifiers were prescribed (Figure 2).

Discussion

The 252 children examined in the three blind schools, although in excess of any blind school survey in Ghana, represent only three per cent of children with blindness in the whole population, which is likely to be approximately 9,360, assuming an estimated prevalence of blindness of 0.9 per 1,000 children.[8] These are some of the weaknesses in blind school studies that limit its external validity. Therefore, our data should be interpreted with caution as this was not a population-based study, and particularly as the time of onset of visual loss could not be determined in two-thirds of cases.

Results from the different locations showed that cataract was the commonest cause of visual loss, accounting for nearly one-quarter of all cases. The prevalence of cataract was similar in northern and southern Ghana. These findings demonstrate significant difference from the earlier experiences[3,4] which portrayed corneal scarring as the major childhood blinding diseases in Ghana. These might indicate a new trend in causes of childhood blindness in Ghana, away from corneal scarring and toward cataract. The pathogenesis of childhood cataract and the ensuing visual loss has been well described in the literature,[20] although in the majority of cases the aetiology was unknown. The high proportion of children blinded by cataract in Ghana[21] may reflect the unmet need for cataract surgical services in the country due to shortage of ophthalmologists. For instance, in northern Ghana, where there are only five ophthalmologists to 5.1 million people, volume seems to be the main factor challenging efficiency in the work of ophthalmologists, thus creating an unprecedented high unmet demand for cataract surgery. For good visual outcome, early detection of cataract, appropriate surgical technique and post-operative follow-up are critical.

Corneal scarring was a more prevalent blinding disease in southern Ghana compared to the north. This finding contradicts the foregoing[8,10] that corneal scarring/phthisis bulbi are more common in the north than in the south because of the poor public health infrastructure in the north that cannot effectively combat the underlying causes. The present trend therefore might hint at the progress that has been made to reduce avoidable blindness caused by corneal scarring in northern Ghana through increased coverage of measles immunisation and vitamin A supplementations.[22] These findings underscore the need for monitoring changing patterns of childhood blindness over time in response to specific interventions.

The difference in age of onset of visual loss in both locations could be attributed to the high proportion of late-onset blindness in the south (40.7 per cent) which was nearly twice that of the north (26.5 per cent). However, rates of congenital-onset blindness were similar in both regions. Nearly half of the conditions leading to blindness in this study could have been treated surgically to prevent visual loss if diagnosed early including congenital cataract and glaucoma. Others such as corneal scarring from measles and vitamin A deficiency could have been prevented through early diagnosis and primary healthcare interventions. Ignorance/lack of parental

awareness, poverty, poor outcomes of surgery reinforcing fear associated with surgery, and superstition constitute major barriers to early treatment.[23–25] These barriers could result in about three years[26] delay in presentation and treatment of congenital cataracts, potentially leading to severe amblyopia. Children in remote villages are more likely than those in urban areas to be amblyopic due to less access to eye-care services. These issues necessitate stronger awareness among mothers and local primary health-care practitioners about the need for timely eye examinations for children. The need for better health education is further highlighted by the fact that only six of the 61 children (10.2 per cent) with cataract actually underwent cataract surgery. Effective strategies to overcome barriers to early presentation should be implemented in developing countries to mitigate the risk of visual loss.

In accordance with observations in other developing countries, retinopathy of prematurity was an extremely rare anomaly in this study. This could be due to low survival rate of preterm babies in Ghana and most developing countries.[27] Second, there is improved neonatal care in controlling complications of retinopathy of prematurity for those who survive.

It is estimated that up to 80 per cent of blindness and severe visual loss in most developing countries could be avoided.[28] The present study showed a slightly higher proportion of avoidable causes (87 per cent) which were potentially treatable. The time of onset of childhood blindness in both regions were similar, mostly attributable to childhood factors but due to small numbers, the etiological data within categories were of limited statistical value. A large proportion of cases of unknown aetiology was encountered in the present study. This observation is consistent with results from other school-based studies in developing countries which used the WHO/PBL guidelines,[7,9,10,29,30] and reflects the limited scope for investigations available. Strategies to broaden the scope for appropriate intervention against childhood blindness in developing countries should be strengthened.

More than one-third of the children had functional low vision, among whom low-vision aids offered the possibility of improving near vision in more than one-third of them. Notably, two students achieved useful vision with refraction and 35 could read N10 ink prints with low-vision devices.[8] Ideally, these children should have had access to low-vision services and offered vision aids before being enrolled into special education schools. Enrolment of children into blind schools without proper assessment of visual potential is a pattern that echoes in many developing countries.[8,30] A previous survey in southern Ghana reported a higher proportion of 43.7 per cent for students with functional low vision among whom two students were able to read N5 and N8 prints, respectively, with spectacle magnifiers.[11] The corresponding proportion in east Africa[30] was 63.9 per cent, among whom 46 per cent could read N5-N8 print. Nevertheless, the majority did not benefit from standard spectacles because they showed no significant improvement in distance vision during assessment. These results underscore the need for mandatory eye examination for assessment of visual potential at the time of school enrolment, and periodic follow-up eye screening for children admitted into special education schools.

In conclusion, cataract was the major cause of childhood blindness in blind schools in Ghana but the rates were not different in the northern and southern areas. However, the southern area had a higher proportion of corneal scarring and late-onset blindness compared with the north. More than one-third of blindness in blind schools in Ghana could have been prevented by primary health-care interventions and nearly half could potentially have been treated surgically to prevent visual loss. Two in five children in blind schools in Ghana could benefit from optical intervention. Our data may be useful for guiding future public health blindness control strategies targeting specific regions.

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