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Blindness and visual impairment in southern Malawi

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There is a paucity of reliable information on the prevalence and causes of blindness in sub-Saharan Africa, and this produces problems in designing and evaluating blindness prevention programmes. To address this problem and to provide baseline data for the evaluation of such programmes, the government of Malawi, in conjunction with a number of agencies, conducted a population-based prevalence survey of ocular disease in the Lower Shire River Valley in southern Malawi, an area where blindness is common. The prevalence of bilateral blindness found (1.27%) is similar to that in other developing countries and represents a significant public health problem. At least 60% of this blindness is preventable or easily reversible.

The few reliable statistics on the magnitude and causes of blindness in sub-Saharan Africa indicate that the problem has widely different prevalences and causes (*1*, *2*). However, the limited number of population-based studies do not specify the proportion of the sample population actually examined, hence precluding estimation of any bias (*3*). In order to gauge the prevalence of major blinding disorders against which programmes to prevent them could be evaluated (*4*), the government of Malawi conducted a population-based survey in the autumn of 1983 in the Lower Shire River Valley, a region of southern Malawi where blindness is particularly common (*5*).

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MATERIALS AND METHODS

Children under 6 years of age formed the principal target population for the survey, but a sample of older children and adults was also selected in order to assess the leading causes of blindness and their impact on the rural population as a whole.

The study area comprised the floor of the Lower Shire Valley, which is divided administratively into the districts of Chikwawa, in the north, and Nsanje, in the south. Excluded from the survey were villages located at altitudes greater than or equal to 76.2 m, the urban centres of Chikwawa and Nsanje, as well as villages on a large sugar plantation or in the National Park, since their environmental conditions were different from those prevailing on the valley floor. Some villages were also excluded if their socioeconomic status was markedly greater than that of the majority of the valley's communities. The study area contained approximately 75% of the valley's population. The 1977 census data for Chikwawa and Nsanje districts served as the sampling frame for the study (*6*, *7*). A systematic cluster sampling technique was used to select villages, and all eligible persons in each village were examined. The sampling frame consisted of 694 communities with a population of approximately 226 000. In contrast, the total population of the Lower Shire Valley in the 1977 census was about 302 000 and, allowing for a 2% annual increment, was approximately 340 000 at the time of the survey. Altogether, 60 sites were selected from a geographically ordered list of villages in the 1977 census, giving a sample of 5000 children under 6 years

of age. From these 60 sites a subsample of 10 was chosen systematically and the entire population of these sites used to study the general prevalence of ocular diseases in the Lower Shire Valley.

Data were collected at three levels: the village or community level, the household level, and the individual level. Village or community level data were collected during a preliminary visit, usually a day or two prior to the arrival of the field team. An interview was conducted with the village chief and other elders to obtain information about the socioeconomic status of the village and the accessibility of sources of water and health care services. Dwellings with children under 6 years of age were identified as were all the dwellings in the subsample of 10 sites selected for the general survey of ocular disease.

Household level data were collected during a census of all dwellings identified as eligible for study during the preliminary visit. All persons currently resident in each dwelling were listed together with their sex, age, and educational level. Occupational and economic data, and information on hygiene practices, as well as distances to major sources of water, were also collected. A short medical history was taken of each child under 6 years of age in the household.

Children under 6 years of age were examined ophthalmologically for signs of xerophthalmia and trachoma using magnifying loupes ($\times 2.5$) and a pen-light. If visual loss was suspected, the ocular media and the posterior pole were further examined using a Kowa hand-held slit lamp and either direct or indirect ophthalmoscopy.

The visual acuity of persons aged at least 6 years was determined using a 6-meter Landolt C chart. Acuities of less than 6/18 were re-tested using a pinhole device. If pinhole vision was less than 6/18, the cause of visual loss was determined by slit-lamp examination and ophthalmoscopy. In addition, the intraocular pressure of all persons $\geqslant 40$ years of age was measured using a Schiotz tonometer.

The nutritional status (length, weight, and the results of a dietary interview) of the following groups was also assessed:

—a 10% systematic sample of all children under 6 years of age;
—all cases of xerophthalmia;
—all cases of corneal ulcers or corneal scarring;
—controls matched by age, sex, and village to the cases of xerophthalmia, corneal ulcer, and corneal scarring.

Children's weights were determined using a hanging Salter scale, which was zeroed prior to each weighing. Length was measured using specially constructed height (length) boards.

Data were collected by three field teams, each directed by an ophthalmologist. Each team consisted of nine members: four health surveillance assistants, three ophthalmic medical assistants, a driver, and a public health nurse. All field staff completed a 2½-week training programme, which included didactic and field training as well as standardization exercises. To avoid diagnostic drift, the ophthalmologists were twice restandardized for trachoma and xerophthalmia grading during the 6-week survey period. Field work was conducted in 1983 during the hot, dry months of October and November.

Two aspects were surveyed: the prevalence of xerophthalmia, trachoma, and other eye disorders in children below 6 years; and the general ocular status of the population aged at least 6 years. The age and sex distributions of children below 6 years of age (response rate >99%) were similar to those of children of this age group in the valley as a whole. For those older than 6 years, the age distribution was also similar to that of the rest of the valley, but the proportion of females in the study group (54.2%) was slightly higher than that in the overall population (51.6%). The overall response rate among those aged $\geqslant 6$ years was 87%, the lowest rate (68%) being among males aged 25–49 years.

Blindness was defined as an acuity of $<3/60$ in the better eye and visual impairment as an acuity in the range $<6/18$ but $\geqslant 3/60$. The etiology of corneal scarring was determined from the clinical characteristics of the cornea, i.e., size, shape, density, and location of scarring, and by a history of illness or other significant events during the month prior to the

Table 1. Age and sex distribution of persons surveyed in the Shire River Valley, 1983

Age group (years)	Sex		Total
	Male	Female	
Persons aged at least 6 years:			
6–29	339 (53.4)[a]	507 (53.9)	846 (53.8)
30–49	159 (25.1)	258 (27.5)	417 (26.4)
50–59	50 (7.9)	91 (9.7)	141 (9.0)
60–69	53 (8.4)	63 (6.7)	116 (7.4)
⩾70	33 (5.2)	21 (2.2)	54 (3.4)
Total	634 (40.3)	940 (59.7)	1574 (100.0)
Persons aged below 6 years:			
0–1	968 (37.3)	1044 (37.1)	2012 (37.2)
2–3	919 (35.4)	1004 (35.6)	1923 (35.5)
4–5	710 (27.3)	770 (27.3)	1480 (27.3)
Total	2597 (48.0)	2818 (52.0)	5415 (100.0)

[a] Figures in parentheses are percentages.

onset of corneal damage. Among children younger than 6 years, the likelihood that corneal scarring was due to xerophthalmia was ranked on a scale from 1 to 5, with 5 = no relationship and 1 = a scar with classic xerophthalmic presentation. Only those scars with ranks of 1 (classic presentation) and 2 (highly likely) were classified as having arisen from vitamin A deficiency.

RESULTS

A total of 1664 persons aged 6 years or more were examined. However, since the visual acuities were not available for 90 of these individuals, only the data for 1574 persons (940 females and 634 males) were used in the analysis. Altogether, 5436 children under 6 years of age were examined, but since the sex of 21 of these children was not recorded, the data for only 5415 were used. Table 1 shows the age and sex distribution for each of the age groups in the survey.

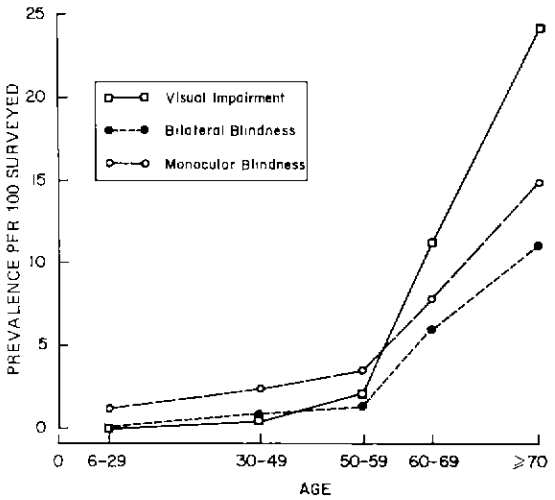

Fig. 1. Prevalence of bilateral blindness, monocular blindness, and visual impairment among persons in the survey aged at least 6 years.

Persons aged at least 6 years

Bilateral blindness is the most serious sequel of ocular disease and imposes significant economic and social burdens on affected individuals and communities. The overall prevalence of blindness among those aged ≥6 years was 1.27% (95% confidence interval, 0.76–1.96%). The prevalence increased markedly with age from less than 1% for those under 50 years of age to over 10% in those aged 70 years or more (Table 2 and Fig. 1). The prevalence of bilateral blindness among males (1.58%) was 50% higher than among females (1.06%), but this difference is not statistically significant ($P = 0.2$). Cataract was the leading cause of bilateral blindness, accounting for 40% of the total (Table 3). Corneal scarring, resulting from smallpox, other infections, or xerophthalmic ulceration, was the second most common cause of blindness, accounting for 30% of the total; while glaucoma, retinal disease, and unknown causes accounted for the remainder. No cases of bilateral blindness caused by trachomatous trichiasis were observed.

Monocular blindness was more than twice as common as bilateral blindness, and increased markedly with age (Table 2 and Fig. 1). In contrast to binocular blindness, corneal pathology was the leading cause of monocular blindness, accounting for 55% of all cases, followed by cataract (24%) (Table 3). Of those with monocular blindness, 7% had severe visual im-

Table 2. Prevalence of monocular and bilateral blindness among persons aged at least 6 years in the survey

Age (years)	No. examined	Monocular blindness			Bilateral blindness[a]		
		No. blind	Prevalence (%)	95% confidence interval	No. blind	Prevalence (%)	95% confidence interval
6–29	846	10	1.2	(0.6–2.2)	1	0.12	(0.01–0.66)
30–49	417	10	2.4	(0.9–3.9)	4	0.96	(0.24–2.45)
50–59	141	5	3.5	(0.5–6.6)	2	1.42	(0.14–5.11)
60–69	116	9	7.8	(2.9–12.6)	7	6.03	(1.70–10.40)
≥70	54	8	14.8	(5.3–24.3)	6	11.11	(2.73–19.49)
Total	1574	42	2.7	(1.9–3.5)	20	1.27	(0.76–1.96)

[a] Blindness defined according to the WHO criteria of acuity <3/60 in the better eye.

Table 3. Cause and prevalence of monocular and bilateral blindness among persons aged at least 6 years in the survey

Cause	Monocular blindness			Bilateral blindness		
	No.	Prevalence (%)	95% confidence interval	No.	Prevalence (%)	95% confidence interval
Cornea-related	23[a]	1.5	(1.0–2.3)	6	0.38	(0 14–0.83)
Cataract	10	0.6	(0.3–1.1)	8	0.51	(0.22–1.09)
Amblyopia	4	0.3	(0.06–0.65)	—	—	—
Glaucoma	—	—	—	3	0.19	(0 04–0.56)
Retinal disease	3	0.2	(0.04–0.56)	1	0.06	(0.01–0.36)
Congenital	1	0.06	(0.006–0.36)	—	—	—
Unknown	1	0.06	(0.006–0.36)	2	0.13	(0.01–0.46)
Total	42	2.7	(1.9–3 5)	20	1.27	(0 76–1.96)

[a] Includes 9 phthisical eyes.

pairment (acuity range, <6/60 to 3/60) in their fellow eye, while a further 7% had moderate visual impairment (<6/18 to 6/60).

In addition to monocular or binocular blindness, 2% of individuals aged at least 6 years had impaired bilateral vision (<6/18 to 3/60). This impairment was closely associated with age (Table 4 and Fig. 1). Cataract accounted for the majority of cases (58.1%), while retinal disease (9.7%), corneal pathology (6.5%), leprosy (3.2%), and glaucoma (3.2%) were together responsible for 22.6% of visual impairments, leaving 19.3% with unexplained pathology. If cases of blindness and visual impairment are combined, 3.3% of all persons aged ⩾6 years had acuities of less than 6/18 in their better eye. Reduced vision was uncommon in those under 30 years of age but was over 14% among individuals aged 50 years or more (Fig. 1).

Table 4. Prevalence of bilateral visual impairment by age among persons of at least 6 years in the survey

Age (years)	No. examined	Visual acuity in better eye: <6/18 to 6/60	<6/60 to 3/60	Total
6–29	846	0	0	0
30–49	417	0	2 (0.5)[a]	2 (0.5)
50–59	141	2 (1.4)[a]	1 (0.7)	3 (2.1)
60–69	116	8 (6.9)	5 (4.3)	13 (11.2)
⩾70	54	10 (18 5)	3 (5 6)	13 (24.1)
Total	1574	20 (1.3)	11 (0.7)	31 (2.0)

[a] Figures in parentheses are percentages.

Children aged less than 6 years

The extent of blindness and visual impairment among children aged less than 6 years was estimated by extrapolating from the data obtained in the clinical examination, since visual acuities were not measured directly. Six children had bilateral blindness, giving a prevalence of 0.11% (95% confidence interval, 0.04–0.24%). All these cases were caused by central corneal scarring, and, based on the clinical characteristics of the children and history of illness during the month prior to onset of blindness, they probably resulted from corneal xerophthalmia. There was no significant difference in the prevalence of age-specific blindness (0–1 years, 0.1%; 2–3 years, 0.1%; 4–5 years, 0.14%), but the number of cases was small.

Cause-specific rates of unilateral visual loss are shown in Table 5. Corneal pathology accounted for 66% of the total, amblyopia/strabismus for 19%, while the remaining 15% were distributed between cataracts (6%), optic atrophy (3%), and other congenital conditions (6%).

DISCUSSION

The survey provides some of the first reliable data on the prevalence of blindness and visual impairment in sub-Saharan Africa, and confirms the initial anecdotal impression that these disorders present a

Table 5. Prevalence of unilateral visual loss by cause among persons aged less than 6 years in the survey

Cause	No. with visual loss	Prevalence (%)	Confidence interval (95%)
Cornea-related	21	0.39	(0.24–0.59)
Amblyopia/strabismus	6	0.11	(0.04–0.24)
Cataract	2	0.04	(0.004–0.13)
Optic atrophy	1	0.02	(0.002–0.10)
Congenital conditions	2	0.04	(0.004–0.13)
Total	32	0.59	(0.40–0.83)

serious public health problem in the Lower Shire Valley. The blindness prevalence (1.27%) is similar to that reported in other studies of sub-Saharan Africa where onchocerciasis is not endemic, and greatly exceeds the WHO criterion for a problem of public health significance. In Kenya, Steinkuller found an overall blindness prevalence of 0.9% (*8*), while data from central Nigeria indicate a prevalence of 1.0% (*9*). Unfortunately, since the age distributions of these two study populations were not reported, age-adjusted comparisons cannot be made. Excluding blindness due to onchocerciasis, Tizazu & Mburu reported a blindness prevalence of 5.2% in southern Sudan (*10*). However, the sampling frame for their study was not well defined, and they used a milder definition of blindness (<6/60) than that recommended by WHO. In this case also, neither the age distribution of the population nor age-specific rates were reported.

The overall prevalence of visual impairment (<6/18) of 3.2% in the Lower Shire Valley is high in view of the young age structure of the population surveyed. In Kenya a similar prevalence (3.7%) has been reported (*11*), while in southern Sudan a prevalence 3.5 times that in the Lower Shire Valley has been reported (*10*).

As in many other developing countries, in the Lower Shire Valley cataract was the leading cause of blindness (40%) and of visual impairment (58%). If a population of 340 000 is assumed, more than 1200 persons in the valley are blind and another 3900 are suffering moderate to severe visual impairment from cataracts. Cataracts also account for 43% of blindness in Kenya (*8*) and 35% in Nigeria (*9*).

Corneal scarring was responsible for 30% of cases of bilateral blindness, but only for 9.7% of those with visual impairment. Although the etiology of such scarring in adults is often difficult to ascertain, the histories obtained suggested that vitamin A deficiency, measles, smallpox, or secondary infections were the most likely causes of the observed pathology. No case of blindness was caused by classic trachomatous trichiasis, which is surprising, considering the high rate of inflammatory trachoma observed in children below 6 years of age (39.3%). Both this discrepancy and the low rate of severe trachomatous scarring and trichiasis in adults suggest that there may have been recent changes in the ecology of trachoma in the study area. In view of the high level of infection of young children with severe inflammatory disease, the prevalence of corneal scarring among adults in the Lower Shire Valley is likely to increase as this cohort of children becomes older.

Fortunately, 86% of those who had monocular blindness had better than 6/18 vision in their fellow eye, and only 7% were nearly blind, i.e., had severe visual impairment, in the fellow eye. The population surveyed is engaged primarily in subsistence agriculture with its associated risk of ocular trauma. Not surprisingly, primarily due to trauma and secondary infections, corneal scarring was the major cause of monocular blindness. This agricultural exposure, combined with poor access to eye care services, probably resulted in a high proportion of injured eyes becoming blind.

Among children, xerophthalmia is a major nutritional disease in the Lower Shire Valley. The prevalence of bilaterally blind children (0.11%), in all of whom corneal scarring was probably the result of vitamin A deficiency, is 2.2 times greater than the level defined by WHO as signifying a problem of public health importance. This does not include those cases where corneal scarring was not severe enough to cause bilateral blindness. Corneal scarring was also responsible for two-thirds of all cases of loss of unilateral vision in children, suggesting that vitamin A deficiency plays a significant role in this respect. In addition, the predominance of vitamin A-related corneal scarring in young children and the absence of such scarring in older age groups suggest that the mortality rate of these children may be higher than that of unaffected individuals. Data from Indonesia support the premise that severe or even mild vitamin A deficiency plays an important role in childhood mortality and morbidity (*12–14*).

The results described here provide background data that can be used to gauge the effectiveness of the blindness prevention programme that is now being implemented in the Lower Shire Valley.[a]

[a] Prevention of Blindness Committee and Government of Malawi. *Lower Shire Valley Prevention of Blindness Programme, Five Year Implementation Plan 1985–1989*. Lilongwe, Ministry of Health, Government of Malawi, 1985.

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RÉSUMÉ

CÉCITÉ ET PERTE DE VISION DANS LE SUD DU MALAWI

Il existe peu de données fiables sur les causes et la prévalence de la cécité dans l'Afrique subsaharienne. Les auteurs ont donc conduit une enquête sur la prévalence des affections oculaires dans la population de la basse vallée de la Shire, au sud du Malawi, pour évaluer l'amplitude du problème dans un secteur à haut risque. Les données obtenues ont servi de base pour l'évaluation d'un programme prévu de prévention de la cécité. Au total, 5436 enfants de moins de 6 ans, ainsi que 1664 sujets âgés de 6 ans et plus, ont été examinés. Soixante grappes ont été obtenues par tirage systématique à partir de la base de sondage constituée par les villages de la basse vallée de la Shire et les données ont été recueillies à différents niveaux, village, ménage et individu. La prévalence de la cécité bilatérale, définie d'après les critères de l'OMS, est de 1,27% chez les 6 ans et plus. Globalement, la prévalence augmente avec l'âge, étant inférieure à 1% chez les moins de 50 ans mais supérieure à 10% à partir de 70 ans. La cataracte est la principale cause de cécité (40%) suivie des cicatrices cornéennes (30%), du glaucome (15%) et des rétinopathies (5%). La prévalence de la cécité monoculaire est de 2,7%, les cicatrices cornéennes représentant 55% des cas, suivies de la cataracte (24%), de l'amblyopie (10%) et des rétinopathies (7%). La perte de vision bilatérale se rencontre chez 2% des sujets âgés d'au moins 6 ans, la cataracte représentant 58% de ces cas. La prévalence de la cécité bilatérale chez l'enfant de moins de 6 ans est de 1,1 pour 1000, représentée en totalité par les cicatrices cornéennes consécutives à la xérophtalmie. Les cicatrices cornéennes sont également la cause des deux tiers des pertes de vision unilatérales chez l'enfant, devant l'amblyopie (19%), la cataracte (6%) et les affections congénitales (6%).

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