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# Distribution and aetiology of blindness and visual impairment in mesoendemic onchocercal communities, Kaduna State, Nigeria

from the Kaduna Collaboration for Research on Onchocerciasis

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**Abstract**

**During a field trial of ivermectin in Kaduna State, northern Nigeria, 6831 people aged 5 years and over, living in 34 mesoendemic savannah onchocercal communities were examined for ocular disease. Visual function assessments included tests of visual acuity and visual fields. A total of 185 individuals (2·7%) were bilaterally blind by acuity criteria with a further 42 blind by field constriction. The overall prevalence of blindness was 3·3%. A further 115 individuals were visually impaired by WHO criteria. Examination for the cause of blindness revealed that 43% of eyes in bilaterally blind patients were blind because of onchocerciasis. A further 11% were blind from optic atrophy much of which was probably onchocercal in origin. Glaucoma was the next most common cause of blindness in the bilaterally blind (11%). Only 6% of eyes were blind from cataract as the primary cause. In the visually impaired population cataract was the most common primary cause of impaired/blind eyes (31%), followed by onchocerciasis (19%).**

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To date the information on blindness in Nigeria has consisted of fragmentary findings collected from cities where the hospitals are based, together with a small and variable proportion of patients drawn from the surrounding rural areas. Better information could be obtained through a national or state survey designed as a stratified population sample as was done with the Gambia national survey.[1] Such surveys are the source of sound data but are difficult to carry out without collaborating expertise, and they are costly. There has not been a significant study of the prevalence and pattern of blindness in Nigerian onchocercal communities published since the work of Rodger and Budden in the 1950s.[2-4]

In Nigeria the population may be crudely divided between urban, periurban, and rural. In the rural population, important causes of blindness include onchocerciasis and trachoma.[5,6] Trachoma is particularly prevalent in some arid areas in northern Nigeria. Onchocerciasis is widely distributed in both forest and savannah habitats, with varying levels of endemicity. This paper presents the findings in a rural population, mesoendemic for guinea savannah onchocerciasis.

The blindness and visual impairment prevalences quoted in this paper are derived from strict adherence to the World Health Organisation definitions[7] and include data for those blind as a result of visual field constriction. Thus our prevalence figures represent the true burden of blindness in the populations examined. Although the WHO advised that in areas where onchocerciasis is present, visual field testing should be included in the basic eye examination,[7] this is rarely done for practical reasons.

## Methods

### POPULATION CHARACTERISTICS

In preparation for a trial of mass community treatment with ivermectin, 36 communities in two areas of Kaduna State, northern Nigeria, expected on entomological grounds to be mesoendemic for onchocerciasis, were identified. These communities took part in a census in 1988. The entomological selection took account of topographic features displayed on the maps of the area as published by Federal Surveys, Nigeria. Of particular interest were indications of sharp changes in river profile, indicating the likely presence of turbulent water in the larger rivers and streams in areas of moderate population density, that could provide favourable conditions for preimaginal stages of vector members of the *Simulium damnosum* complex. Information from aerial prospections for such sites was also available in both areas and was also utilised. Ground prospections guided by these selection criteria confirmed the vectorial situation and allowed focus to be directed towards the final location and selection of the communities studied. Those aged 5 years and over were photographed, registered for inclusion in the trial, and skin snipped. The 34 communities with the highest skin snip positivity were selected for inclusion in the trial.

In the communities selected for study those aged 5 years and over had an overall prevalence of onchocercal infection of 49% (range 22%–82%) while the prevalence rose to 72% (range 39%–93%) among those aged 20 years and over. All the communities were rural, with the vast majority of the population living as subsistence farmers. After explanation of the trial to the village head, the trial, including examination, was offered to all residents over 5 years of age in the selected villages.

### CLINICAL METHODS

In 1988/1989 all 34 communities were revisited and an extensive ophthalmic screening examination performed at a central location in each village with the aim of examining all registered individuals according to a structured protocol. Individuals were examined by a team of six

trained ophthalmic nurses who showed good interobserver agreement for the tests employed. For visual acuity measurement, agreement between ophthalmic nurses returned a $\varkappa$ of 0·74 (weighted $\varkappa$ 0·85) and between nurses and ophthalmologists a $\varkappa$ of 0·65 (weighted $\varkappa$ 0·77) for blind/visually impaired/sighted classification. In repeated measurements on 182 eyes there were no disagreements in the classification of eyes as blind/visually impaired. Four eyes were classified by one observer as sighted and by the other as visually impaired.

The tests employed included visual acuity and visual fields.

*Visual acuity*

Visual acuities were measured using single E optotypes at 6 metres in available outdoor light, with spectacle correction if routinely worn. The following levels of acuity were recorded: 6/9, 6/18, 6/36, 6/60, 3/60, perception of light, and no perception of light. Acuities of less than 6/9 were checked with a pinhole and the result recorded separately.

*Visual fields*

Peripheral visual fields were assessed with the counting fingers field test. Paracentral visual fields were assessed with a 6 mm white target to confrontation and a test for colour desaturation.

In addition, the nurses performed contrast sensitivity and colour vision assessments, examined the external eye, cornea, iris, lens and optic disc, and measured intraocular pressure. Any person found to have a visual acuity of less than 6/9 or a field defect in either eye underwent Friedmann field analysis and was referred to one of two ophthalmologists for examination. The ophthalmologists had a full complement of diagnostic instruments, including slit-lamp with lenses and tonometry, direct and indirect ophthalmoscopes.

After examination the principal cause of impaired vision in each affected eye was recorded together with any secondary and tertiary findings. Thus, for example, for an eye with no perception of light with a non-tumescent cataract in the presence of an unbound, non-reactive pupil, a primary cause of posterior segment pathology of unknown aetiology would be recorded with cataract as a secondary phenomenon. The posterior segment pathology could, of course, be onchocercal optic nerve disease but this could not be positively diagnosed.

## DIAGNOSTIC CRITERIA

*Onchocerciasis*

A primary diagnosis of blindness or visual impairment due to onchocerciasis was made in the presence of gross anterior or posterior segment pathology – namely, marked sclerosing keratitis or onchochorioretinitis. If there were typical anterior segment signs, mild/moderate posterior retinal pathology (confluent retinal pigment epithelial atrophy/chorioretinitis not affecting the whole posterior pole in a Ridley fundus picture), and marked disc pallor, then the diagnosis of onchocercal blindness was also entered. If the anterior segment signs were not considered sufficient to cause blindness and there was no convincing chorioretinal disease in the posterior pole then onchocerciasis was entered as a secondary or tertiary cause. No account was taken of skin snip or skin examination findings in making these diagnoses.

*Optic atrophy*

This was diagnosed when marked disc pallor was present as the major ocular pathology in the absence of a convincing intraocular or extraocular cause for the finding.

*Trachoma*

Visual loss was attributed to trachoma in three instances; firstly, in the presence of active trachomatous keratitis believed to significantly affect vision; secondly, in the presence of old trachomatous scarring (diffuse or focal) believed to significantly affect vision; thirdly, in the presence of phthisis or a central or paracentral scar representing the result of a bacterial ulcer complicating trichiasis/entropion of trachomatous origin (corrected or uncorrected).

*Glaucoma*

The diagnosis of glaucoma was particularly difficult in the population examined since visual field defects from other causes are common. Glaucoma was recorded as the primary cause of visual loss in two situations; firstly, in the presence of classic disc cupping as the major ocular pathology; secondly, if the view of the disc was obscured, the presence of a markedly raised intraocular tension (>35 mm Hg).

*Measles/xerophthalmia*

This diagnosis was entered in the presence of a large scar involving the central or paracentral cornea, commonly with anterior synechiae, but mandatorily with a history of the defect being present since childhood. Although most cases reported measles infection in early childhood this was not always so. The aetiology of such lesions in northern Nigeria has been debated in the past.[8]

*Phthisis bulbi*

Wherever possible the precipitating cause for this end stage finding was determined and entered. For instance in the case of blindness occurring in early childhood following measles then measles/xerophthalmia would be entered. If the precipitating cause was uncertain or not known then phthisis bulbi was entered alone.

## DEFINITION OF BLINDNESS AND VISUAL IMPAIRMENT

The WHO categories of blindness and visual impairment were used (Table 1)[7] including those that were blind by field constriction.

*Table 1 Definitions of blindness and visual impairment*

| | WHO category | Visual acuity in the better eye | | Visual field constriction in the better eye |
|---|---|---|---|---|
| Visual impairment | 1 | <6/18 | | |
| | 2 | <6/60 | | |
| Blindness | 3 | <3/60 | or | <10° |
| | 4 | <1/60 | or | <5 |
| | 5 | NPL | | |

NPL=no perception of light.

## Results

A total of 8139 people aged 5 years and over were registered at census for inclusion in the study. At the time of the ophthalmic examination 12 months later, 84 (1·0%) of these people had died and 256 (3·1%) had moved out of the study areas, leaving a registered population of 7799. Of these individuals, 6831 (87·6%) underwent the ophthalmic examination, while 726 (9·3%) were reported to be absent, 190 (2·4%) refused to participate, and 52 (0·7%) were present but not examined, most commonly because they were ill and unable to attend for examination. A quarter of the population examined reported having taken diethylcarbamazine at some stage in the past.

### DISTRIBUTION OF BLINDNESS AND VISUAL IMPAIRMENT

*Bilateral blindness*

In all, 227 (3·3%) individuals, aged 5 years and over, were found to be bilaterally blind by WHO criteria. Of these, 185 were blind by the acuity criteria and a further 42 were blind by the field constriction criteria.

In the different communities the (unstandardised) prevalence of blindness ranged from 0% in four of the small communities (populations from 16 to 136) to 11·1% in another small community (population 27). The median prevalence of blindness among the communities was 2·4%.

*Changes with age and sex.* Age-specific and sex-specific prevalence rates of blindness are presented in Figure 1. The prevalence rate of bilateral blindness increased with age, from 0·1% among 2533 individuals aged 5 to 14 years to 27% among 194 individuals aged 65 years or more, and was higher among males than females (4·5% *v* 2·2%).

*Figure 1 Age and sex-specific prevalence rates of bilateral blindness in 34 onchocercal communities, Kaduna State, Nigeria.*


The sex difference was statistically significant and was consistent across all age groups. After taking age into account, the risk ratio of blindness for males compared with females was 1·87 (95% confidence interval 1·45 to 2·41; p<0·001). Thus, in this population, males were almost twice as likely to be blind as females.

*Visual impairment*

In addition to those found to be bilaterally blind, 115 individuals (1·7%) were visually impaired according to WHO criteria. Of these, 56 were blind in one eye.

*Changes with age and sex.* As with bilateral blindness, visual impairment was closely associated with age, the prevalence rate increasing from 0·04% among 5 to 14 year olds to 18·6% among those aged 65 years or more.

In contrast to bilateral blindness, visual impairment was slightly more common among females (2·0%) than males (1·4%), with most of this excess occurring among those aged 45 years and over. This sex difference was statistically significant after controlling for age, with a risk ratio for males relative to females of 0·55 (95% CI 0·38, 0·78; p=0·001).

When bilateral blindness and visual impairment were considered together the prevalence rate among males was 5·9% compared with 4·2% among females. Controlling age resulted in an estimated risk ratio of 1·20 (95% CI 1·00, 1·45; p=0·06).

*Unilateral blindness*

A further 183 individuals (2·7%) were found to be unilaterally blind but not visually impaired – that is, blind in one eye but sighted in the other.

*Changes with age and sex.* The prevalence rate of this state increased with age (p<0·001) up to about 45 years, remaining relatively constant thereafter, but there was no strong evidence of any sex difference (p=0·70).

### CAUSES OF BLINDNESS AND VISUAL IMPAIRMENT

Onchocerciasis was the most common cause of bilateral blindness in this population (Table 2).

In 89 bilaterally blind individuals (39·2%) onchocerciasis (not including isolated optic atrophy in the absence of other onchocercal ocular signs) was diagnosed to be the cause of blindness in both eyes, while in a further 18 bilaterally blind individuals onchocerciasis was the cause of blindness in one eye only. In 31 people this was primarily from anterior segment onchocercal disease while in 67 people it was from primarily posterior segment onchocercal disease. The remaining nine people had primarily anterior segment disease in one eye and primarily posterior segment disease in the other eye. Onchocerciasis was also the second most common cause of blindness/visual impairment among visually impaired individuals (18 (15·7%) individuals with bilateral onchocerciasis, eight individuals with unilateral onchocerciasis) and the most common cause of unilateral blindness

*Table 2 Causes of bilateral blindness, visual impairment, and unilateral blindness among those not visually impaired, in 34 mesoendemic onchocercal communities, Kaduna State, Nigeria*

| Cause | Bilaterally blind | | Visually impaired | | Unilaterally blind |
|---|---|---|---|---|---|
| | No of people (%) | No of eyes (%) | No of people* (%) | No of eyes (%) | No of people/eyes (%) |
| Onchocerciasis | 89 (39·2) | 196 (43·2) | 18 (15·7) | 44 (19·1) | 37 (20·2) |
| Optic atrophy | 22 (9·7) | 51 (11·2) | 10 (8·7) | 26 (11·3) | 9 (4·9) |
| Glaucoma | 20 (8·8) | 49 (10·8) | 3 (2·6) | 7 (3·0) | 13 (7·1) |
| Trachoma | 19 (8·4) | 42 (9·3) | 12 (10·4) | 30 (13·0) | 11 (6·0) |
| Cataract | 10 (4·4) | 28 (6·2) | 30 (26·1) | 71 (31·0) | 13 (7·1) |
| Posterior segment pathology | 8 (3·5) | 21 (4·6) | 0 | 4 (1·7) | 3 (1·6) |
| Phthisis bulbi | 4 (1·8) | 19 (4·2) | 0 | 5 (2·2) | 13 (7·1) |
| Measles/xerophthalmia | 2 (0·9) | 4 (0·9) | 1 (0·9) | 3 (1·3) | 34 (18·6) |
| Other corneal opacities | 2 (0·9) | 11 (2·4) | 3 (2·6) | 11 (4·8) | 15 (8·2) |
| Inflammatory | 2 (0·9) | 11 (2·4) | 0 | 0 | 2 (1·1) |
| Trauma | 0 | 4 (0·9) | 0 | 1 (0·4) | 18 (9·8) |
| Refractive error/aphakia | 0 | 1 (0·2) | 11 (9·6) | 27 (11·7) | 1 (0·5) |
| Other | 2(0·9) | 17 (3·7) | 0 | 1 (0·4) | 14 (7·7) |
| Total | 227 | 454 | 115 | 230 | 183 |

*Number of people with same diagnosis bilaterally.

among those unilaterally blind but not visually impaired (37 individuals, 20·2%).

The second most common cause of bilateral blindness was optic atrophy (Table 2). Twenty two bilaterally blind individuals (9·7%) had a diagnosis of optic atrophy in the absence of any other pathology in both eyes while in a further seven individuals optic atrophy was the cause of blindness in one eye. Optic atrophy was also a common cause of blindness/visual impairment in visually impaired individuals (Table 2).

Taken together, onchocerciasis and optic atrophy were the cause of blindness in both eyes in 111 bilaterally blind individuals (48·9%) and were the cause of 247 blind eyes (54·4%) in bilaterally blind people. Among 227 bilaterally blind individuals, onchocerciasis or optic atrophy was diagnosed as the primary cause of blindness in one or both eyes in 136 (59·9%).

Other important causes of bilateral blindness in this population were glaucoma, trachoma, and cataract (Table 2). Together they were the primary cause of blindness in one or both eyes of 68 bilaterally blind people (30%). Uncorrected refractive errors were an important cause of visual impairment.

Among those found to be bilaterally blind by visual field constriction criteria, all had primary diagnoses of onchocerciasis, glaucoma, or optic atrophy not due to intrinsic ocular pathology except for one person with retinitis pigmentosa.

The distributions, by age and by sex, of causes of blind eyes in the bilaterally blind were also examined. The most common cause of blind eyes among the bilaterally blind, in all age groups except the very youngest (5 to 14 years), was onchocerciasis. This accounted for 40%–50% of blind eyes in most age groups. Optic atrophy was the second most common cause of blind eyes (20%) among those aged up to 44 years but was proportionally less important in the older age groups (8%) (Fig 2). Cataract on the other hand was very rare as a cause of blind eyes among those aged less than 45 (one eye, 1%) but was responsible for 8% of blind eyes in those aged 45 years and over. Glaucoma was proportionally more important as a cause of blind eyes in the older age group (12% *v* 7%; Fig 2).

Much of the excess of bilateral blindness among males appears to be due to onchocerciasis (Table 3). There were 77 bilaterally blind males with a primary diagnosis of onchocerciasis in at least one eye compared with only 30 females. Excluding persons bilaterally blind with neither eye blind due to onchocerciasis, and taking account of age, the risk ratio of bilateral blindness with at least one eye blind due to onchocerciasis, for males relative to females, was 2·37 (95% CI 1·60,3·51; $p<0·001$). That is to say, males are more than twice as likely as females to be bilaterally blind with onchocerciasis as the cause of blindness in at least one eye. Onchocerciasis is not, however, solely responsible for the excess of bilateral blindness among males. Excluding those bilaterally blind individuals with onchocerciasis in at least one eye, the risk ratio of bilateral blindness for males relative to females, taking account of age, was 1·54 (95% CI 1·08, 2·20; $p=0·02$). The numbers of individuals and eyes blind because of trachoma and optic atrophy were similar in the two sexes while more females than males were blind because of cataract (Table 3). The remainder of the male excess appears to be due to glaucoma and a variety of other less common causes.

Among the visually impaired the most common causes of blind/impaired eyes in those aged less than 45 were cataract and optic atrophy (eight eyes, 20% each). Among those aged 45 years and over the most common cause of blind/impaired eyes was cataract (63 eyes, 33%). Onchocerciasis was the primary diagnosis in 40 eyes (21%) among those aged 45 years or more. Examining causes of visual impairment by sex suggests that the small excess of visually impaired females noted above is largely due to optic atrophy, cataract, and trachoma with some contribution coming from a variety of other less

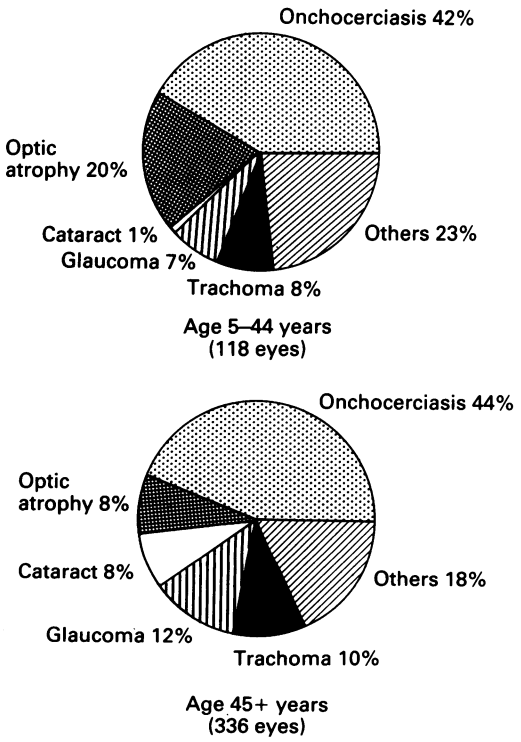


*Figure 2 Causes of blindness among the bilaterally blind aged 5–44 years and 45 years or more, Kaduna State, Nigeria.*

*Table 3 Causes of blindness among the bilaterally blind in 34 mesoendemic onchocercal communities, Kaduna State, Nigeria, by sex*

| | Males | | Females | |
|---|---|---|---|---|
| | *No of people* (%)* | *No of eyes (%)* | *No of people* (%)* | *No of eyes (%)* |
| Onchocerciasis | 61 (40·1) | 138 (45·4) | 28 (37·3) | 58 (38·7) |
| Optic atrophy | 10 (6·6) | 25 (8·2) | 12 (16·0) | 26 (17·3) |
| Glaucoma | 15 (9·9) | 38 (12·5) | 5 (6·7) | 11 (7·3) |
| Trachoma | 11 (7·2) | 24 (7·9) | 8 (10·7) | 18 (12·0) |
| Cataract | 2 (1·3) | 10 (3·3) | 8 (10·7) | 18 (12·0) |
| Other | 18 (11·8) | 69 (22·7) | 4 (5·3) | 19 (12·7) |
| Total | 152 | 304 | 75 | 150 |

*Number of people with same diagnosis bilaterally.

common causes (Table 4). Similar numbers of visually impaired males and females had diagnoses of onchocerciasis or glaucoma.

## Discussion

As might be expected in a community based survey of mesoendemic onchocercal communities, onchocerciasis is by far the most important cause of blindness. Further studies in this population suggest that a substantial proportion of optic nerve atrophy, without any other associated ocular pathology, may be attributable to onchocercal infection. This observation is corroborated by our findings in a community non-endemic for autochthonous onchocerciasis, to be reported elsewhere. Thus, between 50% and 60% of our blind population had onchocercal pathology accounting for blindness in one or both of their eyes.

The pattern of disease encountered in our study population differs in a number of interesting ways from previous reports. A large study by Rodger in the early 1950s[2] found an overall prevalence of 1·2% for blindness for northern Nigeria by the same acuity criteria used in our study. This prevalence was based on estimates of the total population whereas ours is based on a census of those aged 5 years and over. At our census, 17% of the total population were aged less than 5 years, the total population being 8275. On the assumption that none of the under 5 year olds were blind this would give a prevalence of 2·2% for those blind by acuity criteria. This is still considerably higher than his prevalence of 1·2%. The most likely reason for this is that Rodger's data are for both onchocercal and non-onchocercal communities whereas our study communities were specifically chosen on entomological grounds to be likely to be villages with moderate to high levels of onchocercal infection. As it is well established that onchocercal infection in a community significantly affects the number of blind in that community[2] then the differences are not too surprising. Additional factors may be denominator errors in Rodger's calculation of prevalence or a relative improvement in survival among the blind population. We missed 52 people who were unable to attend for examination. These people were older members of the community and probably included a relatively high proportion of blind individuals. Thus, our estimates of the prevalence of blindness may even be an underestimate. On the other hand, absentees are likely to have been sighted.

Trachoma has been previously recorded as the most common, or second most common, cause of blindness in northern Nigeria[4,6] accounting for up to 32% of all cases of blindness or 0·42% prevalence in the whole population. In 1974 Budden reviewed blindness in three separate districts in northern Nigeria for the WHO.[5] He found trachoma accounted for none of the blindness in the Hawal valley, 13% of blindness in Malumfashi district (prevalence unreliable since his work there was incomplete), and 20% of blindness in Garki district near the northern border of Nigeria (0·6% prevalence). We report a smaller contribution by trachoma to the blindness burden at only 7·9% of our blind population or 0·26% prevalence in the whole population. This highlights the focal nature of trachoma infection.

The overall prevalence of blindness due to optic atrophy is considerably higher in our population than in Rodger's studies. Within northern Nigeria he found 0·03% of the population (50 individuals) were blind as a result of optic atrophy in at least one eye[2] compared with 0·42% (29 individuals) in our population. Rodger's study, however, only assessed blindness by acuity criteria. If those 'blind by fields' are excluded from our analysis then 0·20% of our population (14 individuals) were blind with a primary diagnosis of optic atrophy in one or both eyes.

Cataract was the primary cause of visual loss in one or both eyes of 18 blind people (0·26% of the population). This compares with 0·25% of Rodger's population (423 blind from cataract out of 171 091).[2] Thus, the proportion of the population blind as a result of cataract is remarkably stable. These proportions are directly comparable with those elsewhere in west Africa. In the national survey in the Gambia unoperated cataract was responsible for 45% of the blindness. Given a blindness prevalence of 0·7% this suggests that about 0·3% of the population are blind from cataract or uncorrected aphakia.[1]

Couching had been performed in six people in our study population: of those six only one had regained sight. In three of the blind patients the couching was felt to have contributed to the blindness and in the remaining two onchocerciasis was recorded as the main cause of blindness. In 1952 Budden reported two out of 144 bilaterally blind individuals to have been couched.[4]

An excess of bilateral blindness in males as a result of onchocercal infection has been reported previously in northern Nigeria[2,3] and elsewhere in west African savannah villages exposed to onchocerciasis.[9,10] In our population there was no

*Table 4 Causes of blindness/visual impairment among the visually impaired in 34 mesoendemic onchocercal communities, Kaduna State, Nigeria, by sex*

| | Males | | Females | |
|---|---|---|---|---|
| | *No of people* (%)* | *No of eyes (%)* | *No of people* (%)* | *No of eyes (%)* |
| Onchocerciasis | 9 (19·6) | 20 (21·7) | 9 (13·0) | 23 (16·7) |
| Optic atrophy | 2 (4·3) | 9 (9·8) | 8 (11·6) | 17 (12·3) |
| Glaucoma | 1 (2·2) | 3 (3·3) | 2 (2·9) | 4 (2·9) |
| Trachoma | 4 (8·7) | 10 (10·9) | 8 (11·6) | 20 (14·5) |
| Cataract | 13 (28·3) | 31 (33·7) | 17 (24·6) | 40 (29·0) |
| Other | 6 (13·0) | 19 (20·7) | 10 (14·5) | 34 (24·6) |
| Total | 46 | 92 | 69 | 138 |

*Number of people with same diagnosis bilaterally.

substantial difference in prevalence and intensity of onchocercal infection between the sexes suggesting that genetic or hormonal factors need to be considered as possible causes for this sex difference in blindness.

The frequent asymmetry in ocular damage caused by measles when it severely affects the eyes in this population is shown by the relatively large number of individuals unilaterally blind from this cause compared with the small numbers bilaterally blind or visually impaired. Even if all of the phthisis bulbi of uncertain aetiology were due to this cause this pattern would remain the same. The relatively small number of individuals bilaterally blind with a diagnosis of measles xerophthalmia may well be due to increased mortality in this group.

If all infective causes (onchocerciasis, trachoma, and measles) and surgically curable causes (namely, cataract) are taken together then up to 75% (171) of all blind people in the communities studies can be said to have potentially preventable or curable blindness in one or both eyes. If visual impairment and blindness are taken together then up to 81% can be considered to be preventable. The remaining visually handicapped cases number 65 or 1·0% of the population.

In the national survey of blindness in the Gambia the prevalence of blindness (by visual acuity criterion) in all age groups was 0·7%.[1] The equivalent prevalence in all age groups in our communities is 2·2%.

The high overall burden of blindness reported in these Nigerian communities is made all the more apparent when compared with that of England. In England, in 1982, 0·1 million people were registered blind[11] in a population of 49 million,[12] giving a blindness prevalence of 0·2%. Figures estimating the actual prevalence of visual handicap in the community suggest that this may underestimate by 60% the true prevalence of blindness.[13] A figure of 0·6% may therefore be closer to the real situation. If the age-specific and sex-specific blindness rates in our Nigerian population are applied to a population with the same age/sex structure as that of England, then the overall prevalence of blindness would be 7·5%. This means that a Nigerian within the onchocercal communities we examined is 10–15 times more likely to be blind than her or his counterpart in England.

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