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# Eye disease in an onchocerciasis-endemic area of the forest–savanna mosaic region of Nigeria

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*In a forest–savanna mosaic zone of south-eastern Nigeria endemic for onchocerciasis, we identified eye disorders in 65.5% of a randomly selected population sample. Onchocerciasis-related eye disease was present in 13.7% of the study sample and constituted 21% of the total number of eye disorders. A total of 78 (33.2%) of 235 subjects with visual impairment had onchocerciasis-related eye lesions, and of 35 who were blind in both eyes, onchocerciasis-induced eye disease was the cause in 28 (80%). The prevalence of bilateral blindness from all causes in the study area was 4.1%, while that from onchocerciasis-related causes was 3.3%. The commonest onchocerciasis-induced lesions that were responsible for visual impairment and blindness were choroidoretinitis and optic nerve disease. Sclerosing keratitis, an important causative lesion in onchocerciasis-endemic savanna regions, was encountered only once. Eye disease is therefore an important feature of onchocerciasis in the forest–savanna mosaic areas of Nigeria and should be borne in mind when planning and executing control programmes.*

## Introduction

Onchocerciasis is the most important cause of blindness in various areas of Africa and Latin America (1). Estimates indicate that more than 95% of onchocerciasis-infected persons, including those with the most severe infections, are found in Africa (2). Onchocerciasis is highly endemic in Nigeria, where 40 million people are exposed, 7 million are actually infected, and 0.2 million are blind from the disease (3). It occurs with varying levels of endemicity in all geographical zones of the country — forest, savanna, and the forest–savanna mosaic zones.

There are two distinct onchocercal patterns in West Africa — predominantly eye disease in the savanna and predominantly skin disease in the forest zones (4). It has generally been held that there is little or no eye disease in the forest zones. However, in the Oji river local government area in Enugu State, southern Nigeria, we encountered an unexpectedly large amount of blindness among house-bound, middle-aged persons in onchocerciasis-endemic villages. The possibility of a linkage between this observation and onchocerciasis in this forest–savanna mosaic zone of Nigeria led us to undertake a prospective survey of eye disease in the area. Our findings are reported in this article.

## Materials and methods

### Study area

The study was undertaken in 1989–90 in six villages in Achi community, Oji river local government area in Enugu State. The community lies close to a major river, the Oji, where blackfly vectors breed (5). Selection of the community was based on preliminary skin-snip examinations, which showed it to be a mesoendemic zone. The villages are spread over about 4 km<sup>2</sup> and the greatest distance between any two of them is not more than 2 km. The villages are interconnected with each other by laterite-covered, rural roads that can be driven on. The main occupation of the inhabitants is subsistence farming.

### Sampling method

A computer-generated random sample of 500 households was selected from the villages, and from their 4561 occupants a random sample of 859 individuals aged  $\geq 5$  years was chosen as study subjects (343 males and 516 females).

### Clinical and parasitological examinations

All individuals selected underwent a detailed skin examination for onchocercal skin lesions — acute papular onchodermatitis (APOD), chronic papular onchodermatitis (CPOD), leopard skin (LS), atrophy, and lichenification. They were also examined for nodules and “hanging groin”.

Skin snips were removed using corneoscleral punches at two sites — calf and iliac crest — from

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each individual. The snips were immersed in normal saline solution in the wells of microtitration plates and allowed to stand for 24 hours to allow microfilariae to emerge. These were then counted using a low-power light microscope and expressed as counts per mg of skin. The corneoscleral punches were sterilized after use on each study subject before being used on another.

### Ocular examination

Ocular examinations were carried out on all 859 study subjects. Visual acuity was measured using Snellen's E-chart for distance. Visual impairment was defined according to the WHO classification (2): acuity <6/18 to 3/60 or better, with the best correction in the better eye. Blindness was defined as the inability to count fingers at 3 m with the better eye.

The remaining part of the eye examination was conducted in the darkened area of a school hall. Anterior segments were examined for live and dead microfilariae using a pen torchlight and a head-loupe ( $\times 4$  magnification) after subjects had bent their heads for 2 minutes. Corneas were examined for punctate opacities, sclerosing keratitis, and other lesions; anterior chambers and irises were examined for signs of uveitis, and lenses for opacification. Posterior segments were examined by direct ophthalmoscopy in all subjects, except those with total corneal opacity. This examination was done under mydriasis, achieved using 10% phenylephrine hydrochloride solution in individuals with visual acuity <6/9, with the exception of those with a very shallow anterior chamber. Persons who had pathologically cupped discs had their intraocular pressure measured using a Schiottz tonometer. Visual fields were tested by confrontation with finger movements in the paracentral and peripheral areas of the field.

### Ivermectin administration

Ivermectin (Mectizan, Merck Sharp & Dohme) was administered as a single dose of 150 µg per kg body weight. All the study subjects were treated with the drug, with the exception of those who were pregnant, breast-feeding, ill or underweight. The number of individuals thus excluded was 89, making 770 the total number treated, all of whom were monitored for 72 hours after drug administration. All those who received ivermectin were asked to report any adverse symptoms, and appropriate treatment was given for any side-effects reported.

### Study definitions

Glaucoma was suspected if intraocular pressure was >2.93 kPa (>22 mmHg) in the presence of a patho-

logically cupped disc (cup/disc ratio >0.5). Secondary glaucoma was diagnosed when glaucoma was associated with severe anterior segment pathology, for example, severe anterior uveal inflammation. Cataract was diagnosed if there was an opacity in the red reflex behind the pupil. A diagnosis of onchocercal lesions was made if the lesions were typical of those associated with onchocerciasis in persons who were skin-snip positive (microfilarial count >10 per mg skin).

### Patient consent and ethical approval

The aim of the study and the procedures involved were clearly explained to the community heads, household heads, and individual study subjects; consent to participate was voluntarily given by all. The protocol for the study was approved by the Ethics Committee of the University of Nigeria.

### Data management

The findings were recorded on a specially designed form. Computer data entry and analysis were carried out using Epi-Info software. (Public domain software: version 5.01A, March 1991).

## Results

Of the 859 subjects examined, 563 (65.5%) had various eye disorders. Of these, 238 (42.3%) were males and 325 (57.7%) were females; all were within the age range 5–80 years (Table 1).

### Eye findings

The results are summarized in Table 2. A total of 118 individuals had eye lesions that are known to occur as complications of onchocerciasis, this amounted to 13.7% of all the 859 study subjects and 21% of the 563 subjects with eye disease. Of

Table 1: Age and sex distribution of the 563 study subjects with eye disorders

Age group (years)	No. of males	No. of females	Total
5–14	112 (47.1) <sup>a</sup>	94 (28.9)	206 (36.6)
15–29	29 (12.2)	60 (18.7)	89 (15.8)
30–44	25 (10.1)	51 (15.7)	76 (13.5)
45–59	29 (12.2)	67 (20.6)	96 (17.1)
60–74	35 (14.7)	45 (13.8)	80 (14.2)
≥75	8 (3.4)	8 (2.5)	16 (2.8)
Total	238 (100)	325 (100)	563 (100)

<sup>a</sup> Figures in parentheses are percentages.

**Table 2: Frequency of the various types of eye lesions seen among the 563 subjects with eye disease**

Eye disorder	Frequency of lesion*
<i>Nononchocercal eye lesions</i>	
Eyelids	
Hyperpigmentation	16
Conjunctiva	
Pterygium and pinguecula	196
Cornea	
Other corneal lesions	53
Lens	
Cataract	105
Retina	
Other central retinal lesions	102
<i>Onchocercal eye lesions</i>	
Cornea	
Fluffy onchocercal opacities	6
Sclerosing keratitis	32
Anterior chamber and iris	
Iridocyclitis	7
Optic nerve disease	
Disc pallor	51
Glaucomatous optic atrophy	9
Peripapillary atrophy and pigmentation	8
Choroid and retina	
Choroidoretinitis	22
<b>Total</b>	<b>607</b>

\* Some individuals had more than one type of lesion.

those with eye lesions, 32 had sclerosing keratitis (28 bilateral and 4 unilateral) of varying degrees, 4 had signs of acute iridocyclitis, while 3 had torpid iritis. Optic nerve disease, also a known complication of onchocerciasis, was diagnosed in 68 persons, of whom 51 had pallor of the optic discs (46 bilateral and 5 unilateral), 9 had glaucomatous optic atrophy, and 8 had peripapillary atrophy and pigmentation. Choroidoretinitis, another known complication of onchocerciasis, was observed in 22 subjects. The lesions were mostly inactive and located on the temporal area of the retina. Six persons had fluffy onchocercal corneal opacities, four of whom exhibited dead microfilariae in the corneal substance; all those in this group had onchocercal skin lesions and were skin-snip positive. A number of subjects had more than one lesion simultaneously.

Among the eye lesions not usually associated with onchocerciasis but which were observed in the study were pterygium and pinguecula; these were seen in 196 persons. A total of 53 persons had non-specific corneal opacities and degenerations, while cataract was diagnosed in 105 subjects. Central retinal abnormalities, such as pigmentary changes at the macula, age-related macular degeneration, and tigroid fundi, were diagnosed in 102 subjects; some individuals in this group were skin-snip positive for

onchocerciasis but this was regarded as coexistence of two common conditions rather than one causing the other.

A total of 16 of the study participants exhibited hyperpigmentation of the skin of the eyelids. In two of these individuals the condition was associated with classical chronic papular onchodermatitis (CPOD) on the same side of the body, suggesting that the eyelid lesions might be an extension of the body skin lesions. All 16 had other onchocerciasis-related eye lesions.

### Visual impairment and blindness

A total of 235 persons — 27.4% of the total number studied and 41.7% of the 563 with eye disorders — had visual impairment, as did all 105 persons with cataract. For 78 persons, the visual impairment was due to onchocerciasis-related lesions. Blindness was identified in 68 persons, 35 in both eyes and 33 in one eye. Onchocerciasis was considered to be responsible for the bilateral blindness of 28 of these individuals (80% of those bilaterally blind) — 15 as a result of onchocercal choroidoretinitis, 11 as a result of optic nerve disease, and 1 each as a result of sclerosing keratitis and secondary glaucoma complicating uveitis. Of the 105 subjects with cataract 30 were blind in one or both eyes.

### Skin findings

The onchocercal skin lesions were of various types and included APOD, CPOD, LS, skin atrophy and skin nodules. A total of 259 of the 859 subjects examined had onchocercal skin disease. Of the 563 subjects with eye disease, 53 (9.4%) had nodules in the head or neck; and of these, 40 were less than 10 years of age and all were below 15 years of age. All patients who presented head or neck nodules had some form of onchocerciasis-related eye disease.

Among the nononchocercal types of skin disease were leprosy, scabies, and leukoderma.

### Parasitological findings

Skin-snips were positive for onchocercal microfilariae in 259 of the 859 (30.2%) of the study subjects: these individuals were the same as those with onchocercal skin lesions, and the microfilarial load was >10 microfilariae per mg for all positive specimens. The prevalence of microfilarial infection and the geometric mean microfilarial load, according to village, are shown in Table 3.

Microfilarial prevalence varied between the different villages, with Ofia N'Oji and Obodo Ukwu

Table 3: Prevalence and intensity of onchocerciasis infection in the six study villages<sup>a</sup>

Village	mf Prevalence	Intensity of onchocercal infection (geometric mean mf/mg skin)
Mkpokolo	15.6	12.9
Ofia N'Oji	68.4	6.1
Enugu Agu (Umuowulu)	23.2	14.3
Adu	54.6	8.7
Ehuhe	44.2	5.0
Obodo Ukwu	66.4	6.7

<sup>a</sup> mf = microfilaria.

having the highest mf prevalence, while Mkpokolo had the lowest. The overall prevalence of infection was 45.4%.

### Adverse reactions

Four of the study subjects developed conjunctival congestion 1–2 days after ivermectin administration; these were associated with rashes and swelling of the limbs. Another four individuals complained of redness of the eyes and blurred vision; on examination they were found to have signs of iridocyclitis. These reactions lasted only a few days, and some subjects required oral antihistamines in addition to steroid eye drops. Follow-up of these individuals showed that they completely recovered. One individual who had acute anterior uveitis in the left eye before receiving ivermectin developed transient unilateral complete ptosis of the same eye 3 days after receiving the drug.

Two of the children with head nodules developed swelling of the upper limbs associated with rashes.

### Discussion

The prevalence of eye disease in this mesoendemic onchocerciasis zone was 65.5%, considerably more than the 54% reported previously for another onchocerciasis-endemic area of Nigeria (6). It should be borne in mind, however, that some of the disorders we identified were either not normally sight-threatening (pterygium and pinguecula) or were corneal lesions located away from the visual axis (e.g., nonspecific corneal opacities and band keratopathies).

Although cataract is not normally regarded as a direct complication of onchocerciasis, the latter cannot be excluded completely as a contributory factor in onchocerciasis-endemic areas. The frequency of cataract that we found is similar to the level in the

Gambia (7), where a national survey revealed that cataract was responsible for 45% of all blindness. In the present study, cataract was responsible for 45% (105 out of 235) of all visual impairment and 44% (30 out of 68) of all blindness. Other nononchocercal lesions that contributed to the large number of persons with eye disorders included central retinal diseases such as age-related macular degenerations and a variety of pigmentary changes. Eyelid skin hyperpigmentation is an uncommon finding that has previously not been linked with onchocerciasis. The possibility that eyelid hyperpigmentation might be an extension of CPOD suggests that it could be a manifestation of onchocerciasis. This sign could be an important pointer to the presence of onchocercal eye disease, since the latter was present in all subjects with eyelid hyperpigmentation.

Of the eye disorders known to be associated with onchocerciasis, fluffy corneal opacities were seen in six subjects. As a complication of onchocerciasis, this condition usually follows the death of microfilariae in the superficial corneal stroma. Dead microfilariae were observed in only four subjects although this may have been an underestimate because of the relatively low sensitivity of the method used to examine anterior segments (pen torchlight and  $\times 4$  magnification head-loupe). A more sensitive method would have been the use of a slit-lamp but this was not available at the time of the study.

Sclerosing keratitis was responsible for a small proportion of blindness in our study population. This is in contrast to findings in the savanna zone (8, 9), where this condition is a major cause of corneal blindness among those with onchocerciasis. Anderson et al. have suggested that such a difference might be due to a greater predilection of the savanna strains of *O. volvulus* for corneal tissue (8). In our study, the cases of acute iritis and torpid iritis might have been caused by microfilariae in the anterior chamber. The death of such microfilariae causes uveal inflammation, which can result in blinding complications such as glaucoma and cataract (10). In rain forest areas, blindness from onchocerciasis is usually caused by posterior segment involvement — choroidoretinitis and optic nerve disease (9). Also onchocerciasis is widely held to be a cause of optic atrophy (8), as reported in the savanna zone of Nigeria (9). In the present study, optic atrophy was responsible for impaired vision or blindness in 68 persons. All such cases were due to onchocerciasis, with the exception of nine individuals with glaucomatous optic atrophy — a condition that is not usually associated with onchocerciasis.

Choroidoretinal disease is widely recognized to be a complication of onchocerciasis (8, 9), although little is known about its early stages (9). It was found

in 22 of our study subjects, a frequency similar to that reported previously (11).

The overall prevalence of bilateral blindness in our study was 4.1%, while that of blindness due to bilateral onchocercal eye disease was 3.3%. The prevalence of onchocercal blindness is surprisingly high compared with the 1.2% in the savanna zone of Nigeria (9) and the 2.3% in the forest zone of Cameroon (8).

Follow-up during the early post-ivermectin treatment period did not reveal any deterioration of existing eye lesions. However, the fact that nine subjects presented complaints involving the eye underlines a need for careful monitoring of patients for potentially serious eye reactions after ivermectin is administered and this should be borne in mind for mass drug distribution programmes in areas where eye disease is common.

In conclusion, our study has demonstrated a high prevalence of eye disease in an onchocerciasis-endemic area situated in the forest-savanna mosaic zone of south-eastern Nigeria. A large percentage of the eye diseases observed (21%) occurred as complications of onchocerciasis. For most of these, no other causes apart from onchocerciasis were obvious, and it was therefore presumed that they were due in whole or in part to this disease. The prevalences of the various onchocerciasis-related lesions and blindness are higher than those usually reported from onchocerciasis-endemic forest zones although they are lower than the levels in savanna zones. Our findings therefore suggest a progression in the prevalence of eye disease as the ecology changes from forest to savanna through the intervening forest-savanna mosaic zone. Eye disease should therefore be regarded as an important manifestation of onchocerciasis in forest-savanna mosaic zones, and this should be taken into consideration when planning control actions in such areas.

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## Résumé

### Maladies oculaires dans une région de savane boisée du Nigéria où l'onchocercose est endémique

La prévalence des maladies oculaires a été étudiée dans une région de savane boisée du sud-est du

Nigéria où l'onchocercose est endémique. Au total, 859 sujets âgés de 5 à 80 ans, choisis au hasard dans une communauté rurale de 4561 personnes, ont été examinés. On a contrôlé l'acuité visuelle à l'aide de l'échelle E de Snellen et la présence de maladies du segment antérieur et du segment postérieur par ophtalmoscopie directe. La pression intra-oculaire a été mesurée à l'aide du tonomètre de Schiotz.

Des maladies oculaires ont été découvertes chez 563 des 859 sujets examinés, mais dans la plupart des cas, elles ne menaçaient pas la vision (ptérygion, pinguécula, etc.). Des lésions connues pour être des complications de l'onchocercose ont été détectées chez 118 personnes; il s'agissait notamment de kératite sclérosante, de lésions du nerf optique et de chorioretinite. Au total, 235 personnes présentaient une insuffisance visuelle; sur ce nombre, 35 étaient aveugles et 33 avaient perdu la vision d'un œil. Une cécité bilatérale attribuée à l'onchocercose a été observée chez 28 personnes, la plupart du temps en raison d'une lésion du nerf optique ou d'une chorioretinite.

Une onchocercose cutanée (biopsie cutanée positive) a été diagnostiquée chez tous les sujets atteints de troubles oculaires liés à cette maladie. Si certains sujets atteints d'onchocercose cutanée ne souffraient pas de complications oculaires, celles-ci étaient présentes chez tous ceux qui avaient des nodules onchocerquiens au niveau de la tête.

Le traitement à l'ivermectine n'a pas aggravé les lésions oculaires existantes.

Les résultats de l'étude montrent que les complications oculaires de l'onchocercose sont fréquentes dans cette région de savane boisée du Nigéria, avec une prévalence intermédiaire entre celles des zones de savane et de forêt.

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