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Evaluation of E-optotypes as a screening test and the prevalence and causes of visual loss in a rural population in SW Uganda

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Abstract

BACKGROUND Few population-based eye surveys have been conducted in sub-Saharan Africa, limiting the quality of epidemiological information on visual loss from Africa. In the present paper, we describe the prevalence of visual loss in rural Uganda and the screening accuracy of E-optotypes when used by non-medical staff.

METHODS Residents of 15 neighbouring villages were screened for visual loss (<6/18 in either eye) using Snellen's E-optotypes. Individuals who failed were initially referred to an ophthalmic clinical officer (OCO), who retested visual acuity and subsequently referred to an ophthalmologist to determine the cause of visual loss. Subjects from two villages (248 individuals) who passed visual acuity screening were re-examined by the OCO to estimate the accuracy of the screening procedure.

RESULTS Of the 4076 adults (aged 13 years and over, 69.3% of the censused population) who participated, 191 (4.7%) failed the vision screening criteria and 648 (15.9%) had non-vision impairing conditions. The prevalence of visual loss was at least 3.9%: 0.4% had bilateral

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blindness, 1.6% had bilateral visual impairment, 0.7% had unilateral blindness and 1.2% unilateral visual impairment. Cataract was the leading cause for all categories of visual loss except bilateral blindness, for which suspected glaucoma was most frequent. Refractive errors were the second leading cause of bilateral and unilateral visual impairment. Based on one subject (0.4%) in the validation sample who was found to have low vision, we estimated the sensitivity and specificity of E-optotypes for detecting visual loss to be 93% and 99%, respectively.

CONCLUSIONS Cataract and refractive errors were responsible for most of the visual loss in rural Uganda. Snellen's E-optotypes provide a suitable cost-saving tool for conducting population-based eye surveys in sub-Saharan Africa.

Key words Visual impairment; blindness; E-optotypes; vision screening; Snellen's charts; population-based survey; sub-Saharan Africa; Uganda

Introduction Preventable blindness is a global public health problem that disproportionately affects developing nations, where about two-thirds of patients live.¹ Recent estimates by the World Health Organisation suggest the prevalence of blindness in sub-Saharan Africa to be between 1.2% and 1.5%.^{2,3} These estimates for Africa are empirically derived from hospital activity data but these are subject to selection bias, require assumptions of the denominator and may not be generalisable to rural populations. Better estimates can be made from well-conducted large community surveys, but these are often expensive and require trained personnel.⁴

A few population-based surveys conducted in Africa, for example in the Gambia,⁵ Ethiopia,⁶ Benin⁷ and Kenya,^{8,9} reflect the high morbidity due to trachoma or onchocerciasis, which are common in these countries. A recent eye survey conducted in Uganda reported a prevalence of bilateral blindness of 0.5%, visual impairment of 1.8%, with 2.1% suffering blindness or visual impairment in at least one eye.¹⁰ However, this study was limited by low coverage of the target population (53%), a low response rate amongst those who were referred (31%) (preventing diagnoses from being assigned in the majority of patients who failed screening) and unknown sensitivity and specificity of the survey tool, i.e. Snellen 6/18 E-optotypes.¹¹

Snellen 6/18 E-optotypes (E-optotypes), designed for use in illiterate populations, provide a simple and cheap tool for population-based surveys. With appropriate training, E-optotypes can be used by non-medically qualified staff, further reducing the cost of conducting eye surveys. However, the sensitivity and specificity of E-optotypes used by non-medical staff in community eye surveys in sub-Saharan Africa has not been described. We describe the prevalence and causes of visual loss in rural south-west Uganda and the accuracy of detection of visual loss with E-optotypes used by non-medically trained survey staff compared to a full visual acuity assessment carried out by an ophthalmic clinical officer (OCO).

Methods

STUDY POPULATION The study was carried out on adult residents (≥ 13 years of age) living in a cluster of 15 villages in rural south-west Uganda. The cohort was established in 1989 for HIV-1 surveillance through annual censuses and sero-surveys by the Medical Research Council (MRC) (UK).¹² The area is at 1200m above sea level, and is characterised by low-lying hills, and two rainy seasons in March to May and September to November. Subjects live in homesteads (density about 152/km²), and practice subsistence farming (coffee and bananas) as the main economic activity.

This survey of visual loss was carried out alongside one of the annual HIV-1 sero-surveys. Residents who were available and willing to take part in the sero-survey were invited to take part in the eye survey. No attempt was made for either survey to contact residents who had been identified in the most recent census of the population but who were absent from their villages at the time of the survey. An OCO (a medical assistant trained in eye care) worked alongside survey teams in the field.

SCREENING METHODS Survey staff (14), consisting of two nurses, a medical assistant, three field technical assistants and eight mobilisers, were trained in the use of E-optotype cards to screen for low vision. Each card had four E-optotypes (facing in different directions), corresponding to a Snellen visual acuity of 6/18 at 6 metres. The screening procedure was performed in outdoor light on the compound of the participant. Participants stood at 6m; with one eye covered with the palm of the hand they used their free hand to indicate the direction of the 'fingers' of the E-optotype. The optotype card was rotated once and the reading repeated for each eye. If the directions of the optotype fingers were correctly identified three of four times on both tests for one eye, visual acuity for that eye was recorded as 6/18 or better. Otherwise, they were declared to have failed the test.

Subjects who failed the test, who were unable to perform the test and were believed to be blind, or who passed the test but had non-vision impairing conditions (NVIC) or an eye-related complaint were referred to the OCO. The OCO repeated visual acuity testing using Snellen's E-chart with visual categories ranging from 6/5 to 6/60 and then performed a general eye examination. All patients who failed the E-optotype test were also referred to an ophthalmologist at a special fortnightly clinic, for diagnosis and evaluation for treatment. Patients with NVIC were treated in the field, unless the OCO decided that the problem required specialist evaluation by the ophthalmologist, in which case they were also referred to the clinic. The OCO also motivated patients referred for low vision to attend the clinic to see the ophthalmologist.

DIAGNOSIS At the clinic, visual acuity measurements were confirmed and the cause of visual loss determined.¹³ When multiple causes were observed (either in one eye, or in the right and left eyes), the cause most amenable to prevention was assigned. Cataracts were diagnosed

as any lens opacity visible to the ophthalmologist by direct ophthalmoscopy against the red reflex. When refractive error was suspected, visual acuity was measured with a pinhole correction. If the visual acuity improved with a pinhole, refractive error was confirmed using lens power readings from the ophthalmoscope. Central visual loss was attributed to glaucoma on observation of the following features, when no other cause for visual loss could be discerned: (a) pathological optic disc (marked pallor of the nerve head or vertical cupping >0.5) in the presence of intra-ocular pressure >21 mmHg (using a Schiøtz tonometer); (b) markedly raised intra-ocular pressure (>26 mmHg) even without pathological disc; (c) a history of glaucoma surgery or treatment. Age-related disorders such as macular degeneration and retinal abnormalities were diagnosed on clinical grounds.

Patients received treatment at the clinic or were referred to the regional specialist eye clinic at the district capital, about 35 km away, if they needed surgery. In each case, treatment was provided at no cost to the patient and the cost of transport to the regional clinic was paid by the study. Patients, however, paid a nominal fee of about US \$5.00 for spectacles if these were prescribed.

SCREENING ACCURACY OF THE E-OPTOTYPE The screening accuracy of the E-optotype was evaluated against the visual acuity findings of the OCO. However, it was not possible for the OCO to test all participants who passed the E-optotype test, potentially giving rise to 'work-up bias'.¹⁴⁻¹⁶ Although individuals with NVIC who passed the test and who were examined by the OCO constituted a subgroup in which the false negative rate could be estimated, they were deemed unsuitable because they were selected on the basis of an actual or perceived eye problem. Thus, they were unlikely to be representative of the population that passed visual acuity testing but did not have NVIC.

Instead, the false negative rate was estimated by the OCO examining a sample of participants who had passed the E-optotype test. Because the survey team and OCO moved from village to village during the year, the sample was chosen to include all respondents who passed the E-optotype test from the last two villages to be surveyed.

STATISTICAL ANALYSIS Records were checked for completeness and accuracy before being entered in duplicate into a computer database. Any discrepancy between entries was corrected by checking the original form. Visual impairment was defined as visual acuity worse than 6/18 but equal to or better than 3/60, while blindness was defined as visual acuity worse than 3/60. The two categories together constituted visual loss. Five categories of vision were constructed based on the different combinations of visual impairment and blindness in either eye as defined above. The categories are: 1 = normal vision (visual acuity better than or equal to 6/18 in both eyes); 2 = unilateral visual impairment, other eye normal; 3 = unilateral blindness, other eye normal; 4 = bilateral visual impairment (both eyes visually impaired or one eye visually impaired and the fellow eye blind) and 5 = bilateral blindness. All analyses were carried out using STATA 6.0 (Stata software, College Station TX).

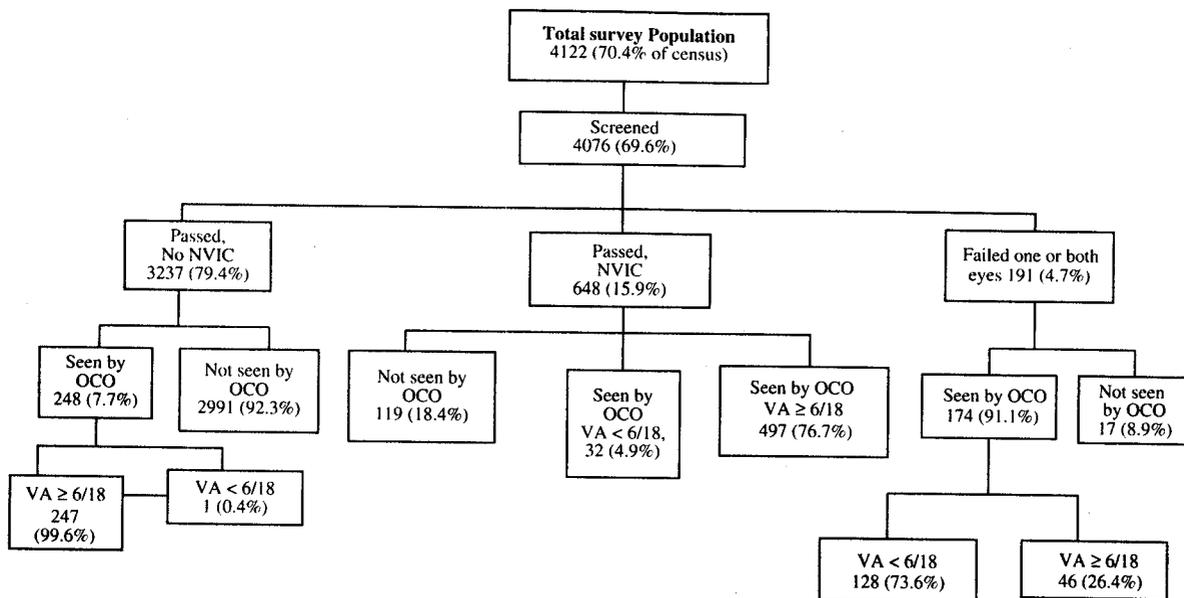


Fig. 1. Flow chart showing the participation in the eye survey.

Results There were 5853 adult residents (13 years or older) according to the most recent census carried out immediately prior to the survey. A total of 4122 (70.4%) participated in the sero-survey, of whom 4076 (98.9%) were screened for visual loss. Participants had a mean age of 31.5 years (range 13–94 years) and 49.1% were male. Figure 1 is a flow chart showing participation in the eye survey. Altogether, 191 of the 4076 (4.7%) individuals failed the E-optotype test in one or both eyes and were referred to the OCO. Of these, 17 (8.9%) were not examined by the OCO because they refused or were absent. Of the 174 (91.1%) who were examined by the OCO, 128 were confirmed to have visual acuity worse than 6/18. The remaining 46 (26.4%) had visual acuity equal to or better than 6/18.

A total of 648 (15.9%) participants who passed the E-optotype test were referred to the OCO because of NVIC; 119 (18.4%) were not examined by the OCO because they refused or were absent. Thirty-two of the 529 examined (6.0%) were found to have visual acuity worse than 6/18 and were referred to the ophthalmologist. Two were bilaterally blind, 14 had bilateral visual impairment, 5 unilateral blindness, and 11 unilateral visual impairment. The remaining 497 had normal visual acuity. Only one of the 248 residents (0.4%; 95% confidence interval 0.0% to 2.2%) in the last two villages who passed the E-optotype test was subsequently found to have visual acuity less than 6/18 when examined by the OCO. Visual acuity in this subject was 6/24 for both eyes and was due to early cataracts.

Thus, the OCO confirmed low vision (visual acuity less than 6/18) in 161 individuals, 128 from those referred for suspected low vision, 32 from among those with NVIC and one from the validation sample. The estimated minimum overall prevalence of visual loss in the population is therefore 3.9% (95% CI 3.4% to 4.6%). If the residents in the last two villages are considered representative of the entire study population, the total number of false negatives expected amongst

the other 2989 participants who passed the E-optotype test but who could not be examined by the OCO would have been 13, giving an estimated overall prevalence of 4.2% ((161 + 12)/4076). Using the upper confidence limit of the false negative rate suggests that the number of false negatives may have been as high as 71 (3237 × 0.022), giving a maximum estimated overall prevalence of 5.7% ((161 + 70)/4076).

The distribution of visual loss was 18 (0.4%) [95% CI 0.3% to 0.7%] bilateral blindness; 67 (1.6%) [95% CI 1.3% to 2.1%] bilateral visual impairment; 29 (0.7%) [95% CI 0.5% to 1.0%] unilateral blindness and 47 (1.2%) [95% CI 0.8% to 1.5%] unilateral visual impairment (see Table 1). The prevalence of visual loss increased with age; compared to the youngest age group (reference group 13–24 years), the odds ratios (OR) of visual loss among people aged 25–44 years, 45–64 years and 65 years and older were 4.4, 20.8 and 129.5, respectively (χ^2 for test for trend = 444, $p < 0.0001$).

Cataract was the most common cause of visual loss for all categories except bilateral blindness, where cataract was the second most common cause after glaucoma. Refractive error was the second most common cause for unilateral and bilateral visual impairment. In four patients (1 with unilateral visual impairment, 2 bilateral visual impairment, and 1 who was bilaterally blind) visual loss was due to uncorrected aphakia. Corneal opacity and macular degeneration were equal second most common causes of unilateral blindness after cataract, but in different age groups. After glaucoma and cataract, optic atrophy was the third most common cause of bilateral blindness (see Table 2).

Table 3 compares the E-optotype results with visual acuity measurement by the OCO, showing data separately for (a) those who failed the E-optotype test, (b) those who passed the E-optotype test but who had a NVIC, and (c) those who passed the E-optotype test and who did not have a NVIC. Given that some patients were not examined by the OCO (because they refused, did not attend or could not be examined

TABLE 1. Distribution of visual loss category by age, n (column %).

	<i>Bilateral blindness</i>	<i>Bilateral visual impairment</i>	<i>Unilateral blindness</i>	<i>Unilateral visual impairment</i>	<i>Total</i>	<i>Population frequency</i>
Age group						
13–24	1 (5.6)	2 (3.0)	2 (6.9)	2 (4.3)	7 (4.3)	1908
25–44	0 (0)	5 (7.5)	5 (17.2)	11 (23.4)	21 (13.0)	1252
45–64	5 (27.8)	18 (26.9)	7 (24.1)	16 (34.0)	46 (28.6)	621
65+	12 (66.7)	42 (62.7)	15 (51.7)	18 (38.3)	87 (54.0)	275
Total	18	67	29	47	161*	4056

*The 161 participants with visual loss consist of 128 who failed the E-optotype test, 32 who were referred for NVIC but failed visual screening by the OCO and one participant identified to have visual loss in the sample evaluated for screening accuracy of the E-optotype test. Frequencies for different age strata do not sum to 4076 because for some patients age was not recorded.

	<i>Bilateral blindness</i>	<i>Bilateral visual impairment</i>	<i>Unilateral Blindness</i>	<i>Unilateral visual impairment</i>	<i>Total</i>
Causes					
Cataract	3 (23.1)	31 (57.4)	15 (62.5)	14 (38.9)	63 (49.7)
Uncorrected aphakia	1 (7.7)	2 (3.7)	1 (4.2)	0	4 (3.2)
Refractive error	0	10 (18.5)	0	6 (16.7)	16 (12.6)
Corneal opacity	1 (7.7)	1 (1.9)	2 (8.3)	5 (13.9)	9 (7.1)
Trachoma	0	0	0	1 (2.8)	1 (1.0)
Glaucoma	5 (38.5)	2 (3.7)	1 (4.2)	1 (2.8)	9 (7.1)
Optic atrophy	2 (15.4)	0	0	1 (2.8)	3 (2.3)
Chorioretinitis	1 (7.7)	3 (5.6)	0	1 (2.8)	5 (3.9)
Chorioretinal scar	0	0	0	1 (2.8)	1 (1.0)
Macular degeneration	0	2 (3.7)	2 (8.3)	3 (8.3)	7 (5.5)
Other	0	3 (5.6)	3 (12.5)	3 (8.3)	9 (7.1)
Total (*)	13 (0.4)	54 (1.6)	24 (0.7)	36 (1.2)	127 (3.9)**

TABLE 2. Distribution of causes of visual loss by visual loss category, n (column %).

*Percentage of each visual loss category in the population.

**In 34 patients not examined by the ophthalmologist there was no cause information.

for logistic reasons), the table shows frequencies in parentheses extrapolated for the whole study population, as well as the raw data.* Clearly, the proportion of participants with NVIC who passed the E-optotype test and were found to have visual loss by the OCO (32/529, 6.0%) was much higher than the proportion of participants without NVIC who passed the E-optotype test and were found to have visual loss by the OCO (1/248, 0.4%). This finding supports our decision not to rely on the NVIC subgroup for evaluating the screening accuracy of the E-optotype.

The sensitivity and specificity of the E-optotype test are important parameters for future users, whether in the context of surveys of prevalence or screening for eye disease. These indices can be estimated from the data in Table 3 in two ways:

(i) The E-optotype results for participants with and without NVICs can be combined. This is the simplest approach, although it takes no account of the heterogeneity between these two groups with respect to their test results. It also assumes that, in the context of using the E-optotype for a survey, no further information about patients with NVIC would be obtained.

*Extrapolation of the results for participants without NVIC is essential to provide a meaningful estimate of sensitivity, given the small proportion of these patients examined by the OCO.

Extrapolation of the results for the other two groups has almost no impact on the estimates of the sensitivity and specificity of the E-optotype.

TABLE 3a. Comparison of the results of the E-optotype test with the full visual acuity assessment carried out by the ophthalmic clinical officer (OCO)*.

	<i>OCO worse than 6/18</i>	<i>OCO better than or equal to 6/18</i>	<i>Total</i>	<i>Not seen by OCO</i>
E-optotype FAIL	128 (141)	46 (50)	174 (191)	17
E-optotype PASS with NVIC**	32 (39)	497 (609)	529 (648)	117
E-optotype PASS without NVIC**	1 (13)	247 (3224)	248 (3237)	2989
Total	161 (193)	247 (3224)	248 (3237)	

*Numbers in parentheses represent extrapolation of the raw data (normal text) to the whole population (n = 4076) to take account of survey participants who were not examined by the OCO.

**NVIC = non-vision impairing condition.

TABLE 3b. Data from Table 3a condensed into a 2 × 2 table for calculation of sensitivity and specificity using method (i) (see text).

	<i>OCO worse than 6/18</i>	<i>OCO better than or equal to 6/18</i>	<i>Total</i>
E-optotype FAIL	141	50	191
E-optotype PASS with or without NVIC	52	3833	3885
Total	193	3883	4076

TABLE 3c. Data from Table 3a condensed into a 2 × 2 table for calculation of sensitivity and specificity using method (ii) (see text).

	<i>OCO worse than 6/18</i>	<i>OCO better than or equal to 6/18</i>	<i>Total</i>
E-optotype FAIL	180	50	191
E-optotype PASS with or without NVIC	13	3833	3885
Total	193	3883	4076

(ii) Alternatively, one can assume that all patients with NVIC will be correctly classified because they will be referred for examination and treatment by the OCO; this is likely to happen whether the E-optotype is being used as a survey tool or as a screening test, since it would be unethical not to investigate further patients who have been identified as having suspected disease.

Using the first method, the sensitivity, specificity and positive predictive value of the E-optotype were estimated to be 73% (141/193), 99% (3833/3883) and 74% (141/191), respectively.

Using the second method, the sensitivity and positive predictive value estimates were much higher (93%, 180/193 and 94%, 180/191) and the specificity remained unchanged.*

Discussion We estimated the minimum prevalence of visual loss in a rural population in south-west Uganda to be 3.9% and the maximum prevalence to be 5.7%. Prevalence within this range is similar to that (4.4%) described from an earlier population-based survey.¹⁰ The prevalence of bilateral blindness in this rural population is higher than in the U.S. (0.4% versus 0.2%) especially considering that American estimates are based on a more liberal visual acuity cut-off criterion for blindness (equal or worse than 6/60).¹⁷ However, compared with other countries, bilateral blindness was less common than in rural Kenya (0.7%),⁹ and much lower than in Nepal (0.9%),¹⁸ Malawi (1.3%)¹⁹ or Tanzania.⁴ Similarly, the prevalence of bilateral visual impairment (1.6%) observed in the study was lower than that observed in Kenya (2.5%),⁹ Ethiopia (2.5%)⁶ and Tanzania⁴ but close to that in Nepal (1.6%).¹⁸ The prevalence of unilateral visual loss, however, was higher than that in Benin (1.1%).⁷ These differences may be due to geographical differences in these countries, to variable quality in data because of differences in sampling designs adopted, differences in the populations chosen for study, the level of provision of eye care services locally or simply sampling error. These reasons for variations between survey estimates highlight that our estimates may not be generalisable beyond south-west Uganda, highlighting the need for more population-based studies in sub-Saharan Africa.

The most common causes of visual loss, regardless of severity, were cataract, refractive error, non-trachomatous corneal opacity, glaucoma and macular degeneration. Cataract was the leading cause, contributing 57.4% of bilateral visual impairment, and 62.5% among those with unilateral blindness. Cataract and glaucoma were responsible for 61.6% of blindness. Sadly, four individuals who received cataract surgery after an earlier eye survey were found to be blind due to uncorrected aphakia. Use of intra-ocular lens implants in the future should reduce the dependence of pseudophakic patients on spectacles for useful levels of visual acuity and increase satisfaction after cataract surgery.

The high blindness rate from glaucoma is not consistent with the findings from glaucoma surveys in sub-Saharan Africa.⁴ In our survey, we did not have the facilities to investigate whether persons suspected to have glaucoma had characteristic glaucomatous visual field loss. Our criteria for attributing a diagnosis of glaucoma therefore do not accord with definitions recently agreed on internationally.²⁰ This limitation may have led us to overestimate the prevalence of glaucoma, although no other cause was apparent in survey participants given this diagnosis. Our findings suggest that the prevalence of glaucoma in this population warrants further investigation.

We observed refractive error, not trachoma, to be the second leading cause of visual loss (12.6%). In this region, trachoma is not endemic, probably because of high rainfall and abundance of water, cultural practice of hand washing, excreta disposal and hygiene. Consequently,

*Confidence intervals are not reported for these estimates because, although they can be calculated from the extrapolated data, such intervals do not take account of the uncertainty arising from the small sample used to estimate false negatives amongst participants without NVIC who passed the E-optotype test.

corneal opacity was not a common cause of bilateral visual impairment or blindness in this population. The corneal opacities observed are most likely to have arisen from injuries.

The sensitivity and specificity of visual acuity screening using an E-optotype operated by non-medically qualified survey staff in rural Africa has not been described before. Estimation of these parameters was complicated because some participants were not examined by the OCO. The estimated sensitivity depends very much on whether one assumes that patients with NVIC will be examined further by someone with ophthalmic training. We believe that this is a reasonable assumption, on ethical grounds, and therefore conclude that the E-optotype test has a high sensitivity and specificity in this rural population. The E-optotype test failed to detect only one person with visual impairment and without a NVIC in the validation sample; this person had borderline visual acuity (6/24) in both eyes.

Our results highlight the value of the E-optotype test in detecting persons with unsuspected visual loss, i.e. without NVIC, in a population-based setting. E-optotypes are easy to use, non-intrusive, adaptable (home or garden or shop) and were acceptable to this rural population. We also used local survey staff who received training in the use of E-optotypes supported by an OCO. Our results provide encouraging evidence that eye surveys can be conducted cheaply using locally available resources.

The number of false negatives identified in the group with NVIC was unacceptably high. These false negative misclassifications may have arisen for a variety of reasons. First, participants with NVIC may genuinely have had variable vision because of the NVIC (e.g., discharge, watering, etc.). Second, they may have co-operated poorly with the E-optotype test because of pain or their concern about the NVIC. Third, some misclassifications may have arisen because of coding errors in the field, i.e. low vision wrongly coded. Finally, some misclassifications may have arisen because of fluctuating acuity in participants with borderline visual acuities; the acuities of a significant proportion of patients would be expected to vary by one Snellen line or more from one occasion to another.²¹

Because subjects diagnosed with NVIC were selected for their eye conditions, they were therefore not representative of all people without NVIC who passed the screening test. Therefore, to obtain valid estimates of the sensitivity and specificity of the E-optotype test, the OCO examined all subjects who had passed the screening procedure from the last two villages. In contrast to the NVIC group, only one false negative was identified in this sample. Since the sample included only respondents from the last two villages, it is possible that the data for the sample are biased because the quality of testing with the E-optotype may have improved during the course of the survey. Unfortunately, we do not have the data to test for this possibility.

The possibility of bias needs to be considered when interpreting our results. The absence at the time of the survey of almost 30% of residents enumerated in the census may have caused us to overestimate the prevalence of visual loss, since those who were not present are likely to have been more healthy and mobile, e.g. absent visiting rela-

tives or working elsewhere.¹¹ However, the eye survey was viewed as an additional service to the community, a factor that improved response rates to the sero-survey. We achieved coverage of 69.3% of the enumerated population compared with only 53% coverage at the earlier survey.¹¹ The proportion of referrals for low vision is similar to the proportion three years earlier (about 4.8%), although the proportion referred for NVIC increased from 8.9% during 1994/1995 to 15.7% in 1997/98. Compared with the first eye survey, survey staff were more likely to refer subjects with NVIC, who in turn were more likely to attend since they were aware that the OCO was travelling around with the survey team and treating NVIC promptly. Our results suggest that visual loss is common in this population, mainly due to cataract and refractive error.

The need for highly trained medical personnel, high coverage (90% or higher), and complex logistic support have prevented eye surveys from being conducted in sub-Saharan Africa. While the cost of this eye study was defrayed by the on-going HIV-1 serological studies, we provide encouraging results that relatively low-cost eye surveys can be conducted in sub-Saharan Africa using E-optotypes by non-medically qualified survey workers backed up by a small number of ophthalmic specialists.

In summary, we found the main causes of visual loss to be either preventable or curable. We also found that testing with a 6/18 Snellen E-optotype by predominantly non-medical personnel had high sensitivity and specificity for the detection of visual loss in our population.

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