Rapid assessment of avoidable blindness in Negros Island and Antique District, Philippines

Article *in* The British journal of ophthalmology · December 2007

DOI: 10.1136/bjo.2007.119123 · Source: PubMed

9 authors, including:

Hannah Kuper
London School of Hygiene and Tropical Me…
209 PUBLICATIONS **6,191** CITATIONS
SEE PROFILE

Sarah Polack
London School of Hygiene and Tropical Me…
42 PUBLICATIONS **948** CITATIONS
SEE PROFILE

WORLD VIEW

Rapid assessment of avoidable blindness in Negros Island and Antique District, Philippines

Cristina Eusebio, Hannah Kuper, Sarah Polack, John Enconado, Noel Tongson, Donald Dionio, Anne DumDum, Hans Limburg, Allen Foster

Br J Ophthalmol 2007;**91**:1588–1592. doi: 10.1136/bjo.2007.119123

See end of article for authors' affiliations

Correspondence to: Hannah Kuper, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK; hannah.kuper@lshtm.ac.uk

Accepted 29 May 2007

Objectives: To conduct rapid assessments of avoidable blindness to estimate the magnitude and causes of blindness in people aged ⩾50 years in Negros Island and Antique district, Philippines.
Methods: Clusters of 50 people aged ⩾50 years were sampled with probability proportionate to size. Households within clusters were selected through compact segment sampling. Visual acuity (VA) was measured with a tumbling ''E'' chart. Ophthalmologists examined people with VA<6/18 in either eye.
Results: In Negros, 2774 of 3649 enumerated subjects were examined (76.0%) and 3177 of 3842 enumerated subjects in Antique (82.7%). The prevalence of blindness (presenting VA<3/60 in better eye) was 2.6% (95% CI = 2.0 to 3.2%) in Negros and 3.0% (2.4 to 3.6%) in Antique. The leading cause of blindness was untreated cataract, and was refractive error for visual impairment (VA<6/18 to ⩾6/60). Most of the cases of blindness (67% in Negros, 82% in Antique) and visual impairment (94% in Negros, 95% in Antique) were avoidable (ie, operated and unoperated cataract, refractive error and corneal scar). In Negros, 23% of eyes had a poor outcome after cataract surgery, and 13% in Antique.
Conclusions: The prevalence of blindness in two areas in the Philippines was relatively low. Since most cases were avoidable, further reductions are possible.

The World Health Organization (WHO) estimated that there were 161 million visually impaired people and 37 million blind people in the world in 2002.[1] These estimates were derived from surveys in only 55 countries, most of which were carried out at the district or regional rather than the national level.[2] There is an urgent need for more up-to-date and accurate surveys, particularly in South East Asia, because of its enormous population size.

The WHO estimates for the area, which includes the Philippines, suggest that the prevalence of blindness is 1.0% in all ages and 6.3% in the population aged ⩾50 years.[1] This is about twice as high as the estimates obtained from the 2002 Philippines national survey, which reported a prevalence of blindness overall of 0.58%, and 2.8% for people aged ⩾50 years.[3] The national survey showed a reduction from an earlier national survey conducted in the Philippines in 1995 which reported an all-age prevalence of blindness of 0.76%.[4] Unfortunately, these surveys do not provide sufficient detail to allow programme planners to estimate the prevalence of blindness at the district level; nor do they provide data about the availability and quality of cataract surgical services.

Negros Island in the Philippines includes the provinces of Negros Occidental and Negros Oriental, which has a total population of approximately 4 million.[5] There are 14 ophthalmologists in Negros who conduct regular cataract surgery to give a cataract surgical rate (CSR) of approximately 1000 surgeries per million people per year (personal communication). Antique district is on Panay Island and has a population of approximately 0.53 million. There is only one ophthalmologist who regularly conducts surgeries and another who refers cases to IloIlo, the capital of the island. Consequently, the CSR in Antique is lower at about 600 operations per million people per year (personal communication). The national survey estimated that the all-age prevalence of blindness in both areas was approximately 0.5–0.6%.[3]

The aim of this study was to conduct a Rapid Assessment of Avoidable Blindness in Negros Island (excluding the two major cities of Bacolod and Dumaguete) and in Antique district, the Philippines, to estimate the prevalence and cause of blindness in people aged 50 years and over and to evaluate the availability and quality of the cataract surgical services.[6 7]

METHODS

Sample selection

Assuming:

- prevalence of blindness in people aged ⩾50 years = 2.8%.[1 3]
- population size of adults aged ⩾50 years = 82 000 (Antique) and 457 000 (Negros)
- required confidence = 95%
- precision = 25%
- design effect = 1.4
- non-response = 20%

the required sample size is 3494 in Antique and 3569 in Negros (using Epi Info 6.04). In total, 70 clusters of 50 adults aged ⩾50 years were required for this survey in Antique and 72 in Negros, but for logistical reasons 77 were selected in Antique and 73 clusters in Negros. The fieldwork was carried out from April to June, 2005 in Negros and from April to May, 2006 in Antique.

The clusters were selected with probability-proportionate to size (separately for Negros and Antique), using updated data from the census in 2000 as the sampling frame.[5–7] In Negros, the two major cities (Bacolod and Dumaguete) were excluded from the sampling frame (population size of approximately 531 300) because the aim was to estimate the prevalence in the underserved rural communities. Households within clusters were selected through compact segment sampling.[8] Maps of the enumeration area showing major landmarks and the approximate distribution of households were obtained or drawn. The

Abbreviation: DEFF, design effect; VA, visual acuity

Table 1 Age composition of district and sample population in Negros and Antique

	Negros		Antique	
Age groups	District	Sample	District	Sample
50–59	216 410 (47%)	1135 (41%)	35 570 (43%)	1061 (33%)
60–69	152 040 (33%)	936 (34%)	26 590 (32%)	1050 (33%)
70–79	66 090 (14%)	515 (19%)	14 320 (17%)	760 (24%)
80+	22 830 (5%)	188 (7%)	5850 (7%)	305 (10%)

enumeration area was then divided into segments, each including approximately 50 people aged ⩾50 years, and one segment was selected at random by drawing lots. The survey team then visited all the households in that segment, door to door, until 50 people aged ⩾50 years were identified. If the target number of 50 people aged ⩾50 years was not reached, another segment was chosen at random and sampling continued. If an eligible household member was absent, at least two return visits were made. Information about visual status was ascertained from relatives or neighbours for people who were not available after repeated visits.

Ophthalmic examination

Visual acuity (VA) was measured with a tumbling ''E'' chart with a Snellen optotype size 6/18 (20/60) on one side and size 6/60 (20/200) on the other side at a distance of 6 or 3 m.[6] Pinhole vision was measured if the VA was less than 6/18 in either eye. All measurements were taken in full daylight with available correction, and people were categorised according to visual acuity with available correction as follows:

- blind: VA<3/60 in the better eye
- severely visually impaired: VA<6/60 but ⩾3/60 in the better eye
- visually impaired: VA<6/18 but ⩾6/60 in the better eye
- normal vision: VA⩾6/18 in the better eye

The lens status of all individuals was assessed by an ophthalmologist using a torch and direct ophthalmoscope in a shaded or dark environment without dilatation of the pupil. All people with presenting VA<6/18 were examined by an ophthalmologist using a direct ophthalmoscope or portable slit lamp, as appropriate. The principal cause of blindness or visual impairment was recorded, assigning the major cause to the primary disorder or (if there are two existing primary disorders that contribute equally to the visual impairment) the that which is easiest to treat.[9]

Training

There were three teams in Negros and four in Antique, each consisting of one ophthalmologist and one assistant (cataract case finder in Negros and midwife in Antique). All staff received 1 week of training. The inter-observer agreement for measurement of VA, lens examination and cause of blindness was assessed between the teams to ensure that it was of an acceptable standard (ie, kappa ⩾0.60).

Statistical analysis

A special software programme (RAAB version 3.1 developed in EPI-INFO v. 6.04d, using the Windows interface provided by EpiData v. 3.1 and by Epi-Info v.3.3.2) was used for data entry and automatic standardised data analysis. The prevalence estimates took account of the design effect (DEFF) when estimating the confidence intervals (calculated in Csample module of EPI-INFO v. 6.04b).

Ethical approval

Ethical approval for this work was granted by the London School of Hygiene & Tropical Medicine (London, UK) and the University of St. La Salle (Bacolod, Philippines). All participants gave verbal consent for the examination. All people with operable cataract or other treatable conditions were referred for treatment.

RESULTS

In Negros, the sample selected included 3649 people, of whom 2774 (76.0%) were examined, 801 (22.0%) were unavailable, and 74 (2.0%) refused to participate. In Antique, the sample selected included 3842 people, of whom 3177 (82.7%) were examined, 578 (15.0%) were unavailable, and 87 (2.3%) refused to participate. The age distribution of the sample was slightly older than expected in both Negros and Antique, based on the age distribution from the census (table 1). Compared with the census distribution, men were somewhat under-represented in both Negros and Antique.

Table 2 Estimated prevalence of blindness, severe visual impairment and visual impairment in Negros and Antique

	Negros			Antique		
VA with available correction	Males (n = 1155)	Females (n = 1619)	Total (n = 2774)	Males (n = 1217)	Females (n = 1960)	Total (n = 3177)
Bilateral blindness						
Number	23	49	72	33	62	95
Prevalence (95% CI)	2.0% (1.2 to 2.8%)	3.0% (2.2 to 3.9%)	2.6% (2.0 to 3.2%)	2.7% (1.8 to 3.7%)	3.2% (2.4 to 4.0%)	3.0% (2.4 to 3.6%)
Bilateral severe visual impairment						
Number	18	22	40	18	21	39
Prevalence (95% CI)	1.6% (0.9 to 2.3%)	1.4% (0.8 to 1.9%)	1.4% (1.0 to 1.9%)	1.5% (0.8 to 2.2%)	1.1% (0.7 to 1.5%)	1.2% (0.8 to 1.6%)
Bilateral visual impairment						
Number	117	189	306	82	151	233
Prevalence (95% CI)	10.1% (8.1 to 12.1%)	11.7% (10.2 to 13.2%)	11.0% (9.6 to 12.4%)	6.7% (5.4 to 8.1%)	7.7% (6.6 to 8.8%)	7.3% (6.4 to 8.2%)

Table 3 Cause of bilateral blindness (VA<3/60), bilateral severe visual impairment (VA<6/60 to 3/60) and bilateral visual impairment (VA<6/18 to 6/60) in people with available correction in Negros and Antique

	Negros			Antique		
	Bilateral Blindness (VA<3/60)	Bilateral severe visual impairment (VA<6/60 to ⩾3/60)	Bilateral visual impairment (VA<6/18 to ⩾6/60)	Bilateral Blindness (VA<3/60)	Bilateral severe visual impairment (VA<6/60 to ⩾3/60)	Bilateral visual impairment (VA<6/18 to ⩾6/60)
	n=72	n=40	n=306	n=95	n=39	n=233
Refractive error	3 (4%)	5 (13%)	164 (54%)	0	5 (13%)	129 (55%)
Cataract, untreated	39 (54%)	30 (75%)	118 (39%)	60 (63%)	28 (72%)	88 (37%)
Aphakia, uncorrected	1 (1%)	0	2 (1%)	0	0	0
Surgical complications	1 (1%)	0	2 (1%)	1 (1%)	0	1 (0.4%)
Phthysis and corneal scar	4 (6%)	0	1 (0.3%)	17 (18%)	1 (3%)	3 (1%)
Posterior segment	22 (31%)	4 (10%)	18 (6%)	15 (16%)	5 (13%)	12 (6%)
Globe abnormalities	2 (3%)	1 (3%)	1 (0.3%)	2 (2%)	0	0
Avoidable blindness	48 (67%)	35 (88%)	286 (94%)	78 (82%)	34 (87%)	221 (95%)

Table 4 Age-adjusted and extrapolated results for the rapid assessment of avoidable blindness, Negros and Antique

	Negros			Antique		
VA with available correction	Males (n=221 670)	Females (n=235 670)	Total (n=457 340)	Males (n=37 770)	Females (n=44 560)	Total (n=82 330)
Bilateral blindness						
Number blind	3715	6230	9945	911	1152	2063
Prevalence (95% CI)	1.7% (0.9 to 2.5%)	2.6% (1.8 to 3.5%)	2.2% (1.6 to 2.8%)	2.4% (1.5 to 3.4%)	2.6% (1.8 to 3.4%)	2.5% (1.9 to 3.1%)
Bilateral severe visual impairment						
Number	2893	2716	5609	445	417	862
Prevalence (95% CI)	1.3% (0.6 to 2.0%)	1.2% (0.6 to 1.7%)	1.2% (0.8 to 1.7%)	1.2% (0.5 to 1.9%)	0.9% (0.5 to 1.5%)	1.1% (0.7 to 1.5%)
Bilateral visual impairment						
Number	19 015	23 820	42 835	2145	2929	5074
Prevalence (95% CI)	8.6% (6.6 to 10.6%)	10.1% (8.6 to 11.6%)	9.4% (8.0 to 10.8%)	5.7% (4.4 to 7.0%)	6.6% (5.5 to 7.7%)	6.2% (5.3 to 7.1%)

The sample prevalence of bilateral blindness with available correction in people aged ⩾50 years was 2.6% (95% CI = 2.0 to 3.2, DEFF = 1.1) in Negros and 3.0% (95% CI = 2.4 to 3.6%, DEFF = 1.1) in Antique (table 2). In both areas, the prevalence of blindness was higher in women (3.0% in Negros and 3.2% in Antique) than in men (2.0% in Negros and 2.7% in Antique). The prevalence of bilateral severe visual impairment was similar in Negros (1.4%, 95% CI = 1.0 to 1.9%, DEFF = 1.0) and Antique (1.2%, 95% CI = 0.8 to 1.6%, DEFF = 1.1), but the prevalence of bilateral visual impairment was higher in Negros (11.0%, 95% CI = 9.6 to 12.4%, DEFF = 1.5) than Antique (7.3%, 95% CI = 6.4 to 8.2%, DEFF = 1.0). In Negros, 82 of the participants were either bilaterally or unilaterally (pseudo)aphakic, and this proportion was similar in men and women. In Antique, 85 participants were bilaterally or unilaterally (pseudo)aphakic, and women were more likely to have bilateral aphakia (1.5%) or unilateral aphakia (1.7%) than men (0.6% and 1.3% respectively).

Untreated cataract was the principal cause of blindness in Negros (54%) and Antique (63%), as well as the major cause of severe visual impairment (75% and 72%, respectively) (table 3). Posterior segment disorders were an important cause of blindness in Negros (31%), but to a lesser extent in Antique (16%). Phthysis and corneal scar were common causes of blindness in Antique (18%) but were rare in Negros (6%). The leading cause of visual impairment was refractive error in both Negros (54%) and Antique (55%), followed by cataract (39% and 37%, respectively). Avoidable causes of blindness, which were those causes that were treatable or preventable (ie, operated and unoperated cataract, refractive error and corneal scar), made up the vast majority of cases of blindness (67% in Negros and 82% in Antique), severe visual impairment (88% and 87%) and visual impairment (94% and 95%).

Extrapolating survey data to the age- and sex distribution of Negros from the census, in people aged ⩾50 years in Negros there are an expected 9945 cases of blindness, 5609 cases of severe visual impairment and 42 835 cases of visual impairment (table 4). Extrapolating survey data to the age- and sex-distribution of Antique, in people aged ⩾50 years in Antique 2063 cases of blindness, 862 cases of severe visual impairment and 5074 visually impaired people were expected. Although the age–sex-standardised prevalence of blindness is higher in Antique (2.5%, 95% CI = 1.9 to 3.1%) than in Negros (2.2%, 1.6 to 2.8%), standardising estimates for both districts by the Antique population distribution removes the difference in the prevalence of blindness (2.5% in both). There are an estimated

Table 5 Cataract surgical coverage (CSC) by person and eyes in people aged ⩾50 years (best correction), Negros and Antique

	Negros		Antique	
	CSC—Persons	CSC—Eyes	CSC—Persons	CSC—Eyes
VA<3/60				
Male	66.7%	45.7%	61.5%	29.4%
Female	58.5%	39.1%	56.4%	38.2%
Total	61.6%	41.6%	57.7%	35.6%
VA<6/60				
Male	64.7%	40.0%	53.3%	26.3%
Female	54.1%	34.2%	50.0%	33.1%
Total	57.9%	36.4%	50.8%	31.1%
VA<6/18				
Male	31.3%	20.5%	30.3%	13.8%
Female	24.7%	15.3%	32.9%	20.0%
Total	27.0%	17.1%	32.1%	18.0%

Table 6 Postoperative visual acuity in eyes following cataract surgery, by IOL status, Negros and Antique

	Negros			Antique		
	Non-IOL eyes (n = 15)	IOL eyes (n = 98)	All eyes (n = 113)	Non-IOL eyes (n = 19)	IOL eyes (n = 101)	All eyes (n = 120)
Available correction						
Can see 6/18	5 (33%)	63 (64%)	68 (60%)	8 (42%)	76 (75%)	84 (70%)
Cannot see 6/18, can see 6/60	4 (27%)	15 (15%)	19 (17%)	5 (26%)	16 (16%)	21 (18%)
Cannot see 6/60	6 (40%)	20 (20%)	26 (23%)	6 (32%)	9 (9%)	15 (13%)
Best correction						
Can see 6/18	6 (40%)	73 (75%)	79 (70%)	9 (47%)	86 (85%)	95 (79%)
Cannot see 6/18, can see 6/60	4 (27%)	13 (13%)	17 (15%)	6 (32%)	9 (9%)	15 (13%)
Cannot see 6/60	5 (33%)	12 (12%)	17 (15%)	4 (21%)	6 (6%)	10 (8%)

5400 people aged ⩾50 years with VA<6/60 due to bilateral cataract in Negros and 1200 in Antique. Assuming that the prevalence of blindness in people aged ⩾50 years is 2.5%, and using the WHO estimates that the prevalence of blindness in those aged <15 years was 0.083% and in those 15–49 was 0.15%,[1] then the population prevalence of blindness was 0.4% in both Negros and Antique. Assuming instead that 80% of blindness is in people aged over 50 years,[1] then the population prevalence of blindness was also 0.4%.

The cataract surgical coverage (CSC, ie, the proportion of all cataract patients or eyes that have received cataract surgery) was moderately high in both Negros and Antique (table 5). Assuming that only cataract with VA<6/60 are operated upon, then in Negros, over half of people with cataract (57.9%) and a third of eyes with cataract (36.4%) had received surgery. The CSC in Antique was similar to that of Negros for both people (50.8%) and eyes (31.1%) at VA<6/60.

The quality of surgery was of concern in Negros, where 1 in 4 eyes (23%) had a poor outcome (VA<6/60) with available correction, although with best correction this improved to 15% of eyes (table 6). Outcomes were better in Antique, where 13% of eyes had a poor outcome, and this was reduced to 8% after best correction. Poor outcome was over three times more likely in eyes that had not received an IOL compared with those that had. In both Negros and Antique, most of the people who had received surgery reported that they were very satisfied (50% Negros, 79% Antique) or somewhat satisfied (36% and 11%) with the surgery. People with bilateral VA<3/60 due to cataract were asked why they had not gone for cataract surgery. Lack of awareness was the major barrier to surgery in Negros (19%) and Antique (35%), followed by the lack of ability to afford surgery (19% and 26%, respectively).

DISCUSSION

Prevalence of blindness

The prevalence of bilateral blindness in rural Negros and in Antique district was lower than the expected prevalence based on the WHO estimates[1] but similar to the estimates from the national survey.[3] Despite the low prevalence, avoidable causes of blindness (operated and unoperated cataract, refractive error and corneal scar) accounted for the majority of blindness, severe visual impairment and visual impairment, showing that further reductions in the prevalence of visual impairment are feasible. The prevalence estimates were similar in Antique and rural Negros, and this is not surprising, since Antique is a relatively underserved area of the Philippines, and the Negros sample was restricted to the rural area.

Cataract

The majority of blindness and severe visual impairment was due to cataract in both areas, and this is in line with the findings from the national survey.[3] The cataract surgical coverage was moderate; 5–6 out of every 10 people with VA<6/60 due to cataract had undergone surgery in both settings. Improving access to cataract surgical services should be a priority in the rural areas of Negros and in Antique. The quality of cataract surgery was of concern, and implementing a monitoring system for cataract surgery could sensitise surgeons to quality control, thereby improving outcomes after surgery.[10–13]

Other causes of visual loss

Refractive error was the leading cause of visual impairment, showing that more optical services are needed. We can also assume that almost all of the people aged ⩾50 years will need presbyopic glasses. Posterior segment disorders were important contributors to blindness and severe visual impairment, supporting other findings that this is a growing area of concern for prevention of blindness.[1] Unfortunately, the cause of the posterior segment disorders could not be diagnosed accurately in this door-to-door survey. Phthysis and corneal scar were common causes of blindness in Antique, perhaps suggesting the occurrence of vitamin A deficiency in the past.

Rapid assessment of avoidable blindness

Both rapid assessments of avoidable blindness took 5 weeks of fieldwork and were relatively cheap and easy to conduct. Compact segment sampling was used to select households within clusters, which is preferable to the random walk method, since there is less subjectivity in the selection of households,[14] and it has a higher precision and a lower risk of bias.[8] The two major cities in Negros were not included in the survey, and so the estimated prevalence and causes of visual impairment relate only to the rural population.

The unexpectedly low prevalence of blindness, compared with the WHO estimates, was also observed in the only two Rapid Assessments of Avoidable Blindness published to date, in Kenya[6] and Bangladesh.[7] If surveys continue to show a lower-than-expected prevalence of blindness, this could have implications for the WHO estimates of the magnitude of blindness.[1]

CONCLUSION

The prevalence of blindness and visual impairment in people aged ⩾50 years on Negros Island and Antique District, Philippines, was relatively low. Despite this, the majority of blindness and visual impairment was due to treatable and avoidable causes, and so even more cases could be avoided in these settings.

ACKNOWLEDGEMENTS

We would like to thank all the participants who took part in the survey, all the survey staff and the local rural health team. We received a lot of support from the Cataract Foundation of the Philippines, and we would particularly like to thank Mavis Campos and Dr Fortunato Eusebio. Hannah Kuper, Sarah Polack and Hans Limburg had full access to all

the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Authors' affiliations

Cristina Eusebio, Cataract Foundation of the Philippines, Bacolod, Philippines
Hannah Kuper, Sarah Polack, Hans Limburg, Allen Foster, International Centre for Eye Health, London School of Hygiene & Tropical Medicine, London, UK
John Enconado, Fatima Eye Center, Manila, Philippines
Noel Tongson, Anne DumDum, Iloilo Provincial Hospital, Iloilo, Philippines
Donald Dionio, Western Visayas Medical Center, Iloilo, Philippines

This work was supported by grants from SightSavers International, Christian Blind Mission and ORBIS International.

Competing interests: None declared.

REFERENCES

1 **Resnikoff S**, Pascolini D, Etya'ale D, *et al*. Global data on visual impairment in the year 2002. *Bull World Health Org* 2004;**82**:844–51.
2 **Pascolini D**, Mariotti SP, Pokharel GP, *et al*. 2002 global update of available data on visual impairment: A compilation of population-based prevalence studies. *Ophthalmic Epidemiol* 2004;**11**:67–115.
3 **Olivar-Santos EO**, Cubillan LDP. *Philippine national survey on blindness*. Manila, Philippines: Department of Health, 2004.
4 **Olivar-Santos EO**. Second national survey of blindness, Philippines, 1995. *Philippine J Ophthalmol* 2000;**25**.
5 **Census Planning and Operations Division**. *2000 census of population and housing*. Manila, Philippines: National Statistics Office, 2004.
6 **Mathenge W**, Kuper H, Polack S, *et al*. Rapid assessment of avoidable blindness in Nakuru district, Kenya. *Ophthalmology* 2007;**114**:599–605.
7 **Wadud Z**, Kuper H, Polack S, *et al*. Rapid assessment of avoidable blindness and needs assessment of cataract surgical services in Satkhira district, Bangladesh. *Br J Ophthalmol* 2006;**90**:1225–9.
8 **Turner AG**, Magnani RJ, Shuaib M. A not quite as quick but much cleaner alternative to the expanded programme on immunization (epi) cluster survey design. *Int J Epidemiol* 1996;**25**:198–203.
9 **Programme for the Prevention of Blindness and Deafness**. *Coding instructions for the WHO/PBL eye examination record (version iii)*. Geneva, Switzerland: World Health Organization, 1988.
10 **Limburg H**, Foster A, Vaidyanathan K, *et al*. Monitoring visual outcome of cataract surgery in India. *Bull World Health Organ* 1999;**77**:455–60.
11 **Yorston D**, Gichuhi S, Wood M, *et al*. Does prospective monitoring improve cataract surgery outcomes in Africa? *Br J Ophthalmol* 2002;**86**:543–7.
12 **Limburg H**, Foster A, Gilbert C, *et al*. Routine monitoring of visual outcome of cataract surgery. Part 2: Results from eight study centres. *Br J Ophthalmol* 2005;**89**:50–2.
13 **Limburg H**, Foster A, Gilbert C, *et al*. Routine monitoring of visual outcome of cataract surgery. Part 1: Development of an instrument. *Br J Ophthalmol* 2005;**89**:45–9.
14 **Milligan P**, Njie A, Bennett S. Comparison of two cluster sampling methods for health surveys in developing countries. *Int J Epidemiol* 2004;**33**:469–76.