Rapid Assessment of Avoidable Blindness in Nakuru District, Kenya

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Objectives: To estimate the prevalence of avoidable blindness in ≥50-year-olds in Nakuru district, Kenya, and to evaluate the Rapid Assessment for Avoidable Blindness (RAAB), a new methodology to measure the magnitude and causes of blindness.

Design: Cross-sectional population-based survey.

Participants: Seventy-six clusters of 50 people 50 years or older were selected by probability proportionate to size sampling of clusters. Households within clusters were selected through compact segment sampling. Three thousand seven hundred eighty-four eligible subjects were selected, of whom 3503 (92.6%) were examined.

Methods: Participants underwent a comprehensive ophthalmic examination in their homes by an ophthalmologist, including measurement of visual acuity (VA) with a tumbling-*E* chart and the diagnosis of the principal cause of visual impairment. Those who had undergone cataract surgery were questioned about the details of the operation and their satisfaction with surgery. Those who were visually impaired from cataract were asked why they had not gone for surgery.

Main Outcome Measures: Visual acuity and principal cause of VA<6/18.

Results: The prevalence of bilateral blindness (presenting VA < 3/60) was 2.0% (95% confidence interval [CI], 1.5%–2.4%), and prevalence of bilateral visual impairment (VA of <6/18–≥6/60) was 5.8% (95% CI, 4.8%–6.8%) in the sample. Definite avoidable causes of blindness (i.e., cataract, refractive error, trachoma, and corneal scarring) were responsible for 69.6% of bilateral blindness and 74.9% of bilateral visual impairment. Cataract was the major cause of blindness (42.0%) and visual impairment (36.0%). The cataract surgical coverage was high, with 78% of those with bilateral cataract who needed surgery having had surgery at VA<3/60. The quality of surgery was of concern because 22% of the 222 eyes that had undergone cataract surgery had VA<6/60 with best correction. The main barriers to surgery were lack of awareness and cost. The RAAB methodology was easy to use, and each team could visit one cluster per day.

Conclusions: The prevalence of blindness in ≥50-year-olds in Nakuru district was low, in part due to the high cataract surgical coverage. The RAAB is easy to use and inexpensive and provides information about the magnitude and causes of avoidable blindness that can be used for planning and monitoring eye care services. *Ophthalmology 2007;114:599–605 © 2007 by the American Academy of Ophthalmology.*

Global estimates suggest that in 2002 there were more than 161 million people who were visually impaired (bilateral visual acuity [VA] < 6/18 with best correction), of whom approximately 37 million were blind (bilateral VA < 3/60).[1] Vision 2020: The Right to Sight is a global initiative that aims to eliminate avoidable blindness by the year 2020. It was launched in 1999 by the World Health Organization and the International Agency for the Prevention of Blindness together with more than 20 international nongovernmental organizations. The priority diseases in the first phase of Vision 2020 are cataract, refractive error and low vision, childhood blindness, onchocerciasis, and trachoma. These conditions constitute more than 75% of blinding diseases[1] and are amenable to effective preventive and curative interventions.

Eye care programs are often limited in resources and need to allocate these as efficiently as possible. The efficient implementation and monitoring of eye care programs is constrained by the lack of data concerning the prevalence and causes of blindness and visual impairment, particularly in Africa. There have been few large-scale surveys of blindness, because they are expensive and time consuming.

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Rapid methods, notably the Rapid Assessment of Cataract Surgery Services (RACSS), have been developed to estimate the prevalence of blindness and visual impairment and the proportion that is due to cataract.[2] The RACSS is rapid because it measures visual impairment only in those over 50 years, who account for over 85% of blindness in the population yet a small proportion of the total population size. Although the RACSS is restricted to those over 50, it should still provide a good estimate of causes of blindness in the population, as the proportion of blindness due to different causes is the same in those over 50 as in the total population, as most cases of blindness involve older people.[3] The RACSS has been undertaken successfully in a range of countries.[4–9] In some settings, particularly in Africa, there are important causes of avoidable blindness besides cataract, such as trachoma and refractive error.[1] The RACSS therefore has been adapted to create the Rapid Assessment of Avoidable Blindness (RAAB). The RAAB includes more detailed data on causes of low vision and blindness besides cataract, a new recommended method for sampling individuals within clusters, and clearer guidelines about dilatation during ophthalmic examination, and has an updated data entry and analysis package with extra reports and consistency checks.

Two previous surveys show a relatively high prevalence of blindness in Kenya,[10,11] although these were conducted more than 15 years ago. The prevalence of blindness was 0.7% in a survey of 13 803 people of all ages living in rural areas across Kenya.[11] A second survey among the Turkana in northwest Kenya found a slightly higher prevalence of blindness, at 1.1% of the 900 examined (all ages).[10] Both studies reported that cataract was the most important cause of blindness, responsible for 4 of every 10 cases of blindness. These findings are consistent with the recent global estimates suggesting that 1% of Africans are blind, and half of this is due to cataract.[1]

Nakuru district lies north of Nairobi. It has approximately 1.3 million inhabitants, 1 in 5 of whom live in Nakuru city, whereas the rest are rural.[12] Nakuru district is the farmers' capital of Kenya, famous for its agriculture-based industries that serve the surrounding hinterland. Nakuru is a representative Kenyan district in terms of ethnic population composition and economic characteristics. The district is served by the Rift Valley Provincial Hospital, which has a 48-bed dedicated eye facility staffed by one ophthalmologist. There are also 3 ophthalmic clinical officers, who have undergone 3 years of training in a paramedical college in basic health sciences with a further year of training in ophthalmic sciences, 2 of whom received additional training to be cataract surgeons. Approximately 700 cataract operations are performed at the unit each year, and 97% of these involve an intraocular lens (IOL). Eye surgeries also are performed by private practitioners and visiting ophthalmologists in short-term eye camps, and some private patients go to Nairobi for surgery. The overall cataract surgical rate in Nakuru is approximately 1000 surgeries per 1 million people per year.

The objectives of this study were to estimate the prevalence of avoidable blindness in the Nakuru district of Kenya and to evaluate the RAAB survey methodology.

Materials and Methods

Sample Selection

The expected prevalence of blindness in ≥50-year-olds was estimated conservatively at 4.5%.[1,10,11] Allowing for a required confidence of 95%, precision of 20% (i.e., worst acceptable result of 3.6%), population size of 88 700 people 50 or older in Nakuru,[12] expected design effect of 1.7 for clusters of 50 based on data from the RACSS,[2] and 10% nonresponse, the required sample size was estimated to be 3725 subjects (Epi Info 6.04, Centers for Disease Control and Prevention, Atlanta, GA). In total, 75 clusters of 50 people 50 or older were required for this survey, but for logistical reasons, 76 were selected.

The last national census was conducted in Kenya in 1999; thus, the population estimates per settlement were no longer reliable. Fortunately, a general election was held in 2002, and during this process, lists were drawn up of all the eligible ≥18-year-old voters. Electoral role data were used as the sampling frame for this survey. A list was produced of polling stations and their respective population sizes. The approximate population size of those 50 or older was estimated for each polling station based on the population distribution and population growth from the census (Table 1).[13] A column was created with the cumulative population across the settlements. The total population age 50 or older (481 051) was divided by the number of clusters required (i.e., 76) to derive the sampling interval (6330). The first cluster was selected by multiplying the sampling interval by a random number between 0 and 1 (e.g., if the random interval is 0.965, then the first cluster would be $6330 \times 0.965 = 6108$). The resulting number was traced in the cumulative population column, and the first cluster was taken from the corresponding polling station (in this example, it was Nakuru West Secondary School). The following clusters

Table 1. Example to Demonstrate Probability Proportionate to Size Selection of Clusters

Polling Station	Population Size	Population ≥50 Years Old	Cumulative Population	Cluster Selected
Nakuru town	3831	613	613	
Technology Farm High School	22 056	3529	4142	
Nakuru West Secondary School	18 744	2999	7141	Cluster 1
Kaptembwa Primary School	30 719	4915	12 056	
County Council Hall	34 363	5498	17 554	Cluster 2
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
Total population			481 051	

were identified by adding the sampling interval to the previous number (6108+6330 = 12 438 [County Council Hall]). This systematic sampling procedure is random and selects clusters with a probability proportional to the size of the population.

The second stage of sample selection, that of selecting households within clusters, was through compact segment sampling.[14] The polling station was visited 2 to 3 days before the survey, and the village leaders were asked if they could produce a sketch map of the polling area showing major landmarks and the approximate distribution of villages and households. The polling area was then divided into segments so that each segment included approximately 50 people age ≥50 years. For instance, if a polling station included 300 people 50 or older, then it would be divided into 6 segments. One of the segments was chosen at random by drawing lots, and all households in the segment were included in the sample sequentially, until 50 people 50 or older were identified. A household was defined as a group of people living and eating together at least 3 months of the year. If the segment did not include 50 people 50 or older, then another segment was chosen at random and sampling continued.

The survey team was assisted in the clusters by a village guide, appointed by the village leaders. The survey team visited households door to door and conducted the visual examinations in the household. The purpose of the study and examination procedure were explained to the subjects, and verbal consent was obtained before examination. If an eligible person was absent, the survey team returned at least twice to the household on the same day to examine him or her before leaving the area. If after repeated visits he or she could not be examined, information about his or her visual status was collected from relatives or neighbors.

Ophthalmic Examination

A standardized protocol was used for the rapid assessment of avoidable blindness (RAAB). A survey record was filled out for each eligible person, which included 7 sections: general information; vision and pinhole examination; lens examination; principal cause of vision impairment; history, if not examined; why cataract operation had not been done; and details about the cataract operation.

Visual acuity was measured with a Snellen tumbling-*E* chart using optotype size 6/18 (20/60) on one side and size 6/60 (20/200) on the other at 6 or 3 m. All measurements were taken in full daylight with available correction. If the VA was <6/18 in either eye, then pinhole vision also was measured. Blindness was defined as VA<3/60 in the better eye with available spectacle correction. Severe visual impairment was VA ≥3/60 to <6/60 and visual impairment was VA ≥6/60 to <6/18, both with available correction.

Next, all participants were examined by an ophthalmologist in their household. Lens status was assessed by flashlight or by distant direct ophthalmoscopy in a shaded or dark environment without dilation of the pupil and was graded as normal lens, obvious lens opacity present, lens absent (aphakia), or IOL implantation. If the lens could not be examined (e.g., corneal scarring present), then "no view of lens" was noted. The ophthalmologist examined all eyes with a presenting VA < 6/18 with a flashlight, direct ophthalmoscope, and/or portable slit lamp in a shaded area, after pupil dilation where appropriate to diagnose the cause of visual impairment. The ophthalmologist recorded the principal cause of blindness or visual impairment using the World Health Organization convention whereby the major cause is assigned to the disorder that is easiest to treat.[15]

Training

There were 3 teams, each consisting of one ophthalmologist and one ophthalmic clinical officer. The teams received 1 week of training. To measure interobserver agreement, 40 patients were examined by each of the 3 teams, and the measurement of VA, lens examination results, and cause of blindness were compared between the teams to ensure that they were of an acceptable standard (i.e., $\kappa \geq 0.60$). Teams were accompanied by a field supervisor at least 1 day per week to ensure that high quality was maintained. The fieldwork was carried out from January through February 2005.

Statistical Analysis

A software program developed for this survey (RAAB version 3.1, developed in Epi Info 6.04d using the Windows interface provided by EpiData version 3.1 [Centers for Disease Control and Prevention] and Epi Info version 3.3.2) was used for data entry and automatic standardized data analysis. The prevalence estimates took account of the design effect when estimating the confidence intervals (CIs; calculated in the Csample module of Epi Info version 6.04b). Cataract surgical coverage of people, or the proportion of people needing surgery who had undergone cataract surgery, was calculated by dividing the number of cataract surgeries (number of people with bilateral pseudophakia/aphakia plus the number of people with unilateral pseudophakia/aphakia and unilateral vision-impairing cataract) by the sum of the number of surgeries plus the number of individuals visually impaired from cataract. Cataract surgical coverage also was calculated for eyes.

Ethical Approval

Ethical approval for this work was granted by the London School of Hygiene & Tropical Medicine and the Kenya Medical Research Institute Ethical Committee and Nakuru District

Table 2. Age and Gender Composition of District and Sample Populations

Age Groups (yrs)	Males		Females		Total	
	District	*Sample*	*District*	*Sample*	*District*	*Sample*
50–54	13 907 (31.2%)	457 (27.4%)	13 721 (31.0%)	569 (31.0%)	27 628 (31.1%)	1026 (29.3%)
55–59	10 081 (19.8%)	295 (17.7%)	10 076 (22.8%)	310 (16.9%)	20 157 (22.7%)	605 (17.3%)
60–64	7432 (18.2%)	314 (18.8%)	7412 (16.8%)	299 (16.3%)	14 844 (16.7%)	613 (17.5%)
65–69	5482 (12.8%)	178 (10.7%)	5452 (12.3%)	168 (9.2%)	10 934 (12.3%)	346 (9.9%)
70–74	3753 (11.5%)	173 (10.4%)	3706 (8.4%)	212 (11.6%)	7459 (8.4%)	385 (11.0%)
75–79	2208 (5.4%)	96 (5.8%)	2205 (5.0%)	82 (4.5%)	4413 (5.0%)	178 (5.1%)
≥80	1656 (8.2%)	156 (9.3%)	1623 (3.7%)	194 (10.6%)	3279 (3.7%)	350 (10.0%)
Total ≥50	44 519	1669	44 195	1834	88 714	3503

Based on the population distribution in Nakuru[12] and Kenya.[13]

Table 3. Sample Results for the Avoidable Blindness Survey, Nakuru District

VA with Available Correction	Males (n = 1669)		Females (n = 1834)		Total (n = 3503)	
	n	*Prevalence (95% Confidence Interval)*	*n*	*Prevalence (95% Confidence Interval)*	*n*	*Prevalence (95% Confidence Interval)*
<3/60, bilateral blindness	32	1.9% (1.2%–2.6%)	37	2.0% (1.4%–2.7%)	69	2.0% (1.5%–2.4%)
<6/60–≥3/60, bilateral severe visual impairment	32	1.9% (1.2%–2.7%)	22	1.2% (0.7%–1.7%)	54	1.5% (1.1%–2.0%)
<6/18–≥6/60, bilateral visual impairment	94	5.6% (4.4%–7.0%)	109	5.9% (4.8%–7.1%)	203	5.8% (4.8%–6.8%)
Bilateral aphakia/pseudophakia	35	2.1% (1.4%–2.8%)	42	2.3% (1.5%–3.0%)	77	2.2% (1.7%–2.7%)
Unilateral aphakia/pseudophakia	38	2.3% (1.6%–3.0%)	33	1.8% (1.2%–2.5%)	71	2.0% (1.5%–2.5%)
Aphakic/pseudophakic eyes	108	3.2% (2.4%–4.1%)	117	3.2% (2.4%–4.0%)	225	3.2% (2.6%–3.9%)

VA = visual acuity.

Health Management Team. The research followed the tenets of the Declaration of Helsinki. Informed consent was obtained from the subjects after explanation of the nature and possible consequences of the study. All people with operable cataract were referred for free treatment. All people with other treatable conditions were referred for treatment.

Results

The study population consisted of 3784 people. Two hundred twenty-two (5.9%) were not available, and 59 (1.6%) refused to be examined, so 3503 were included in the survey (92.6%). There was no difference in mean ages of those who were unavailable (61.3 years), those who refused (61.0), and those who were included (62.3), but those who refused were more likely to be female (66.1% of refusers vs. 46.9% of those unavailable and 52.4% of those examined). Of the 222 who were not available, 2 were believed to be blind and 8 were believed to have undergone cataract surgery. The sample of 3503 examined included 1669 men (47.6%) and 1834 women (52.4%) (Table 2). There was a slight overrepresentation of elderly people (≥80) in the sample, particularly elderly women.

There were 69 bilaterally blind people, giving a sample prevalence of blindness of 2.0% (95% CI, 1.5%–2.4%) with an observed design effect of 1.3 (Table 3). The prevalence of severe visual impairment was 1.5% (95% CI, 1.1%–2.0%; design effect, 1.0), and prevalence of visual impairment was 5.8% (95% CI, 4.8%–6.8%; design effect, 2.0). The cumulative prevalence of presenting VA < 6/18 was 9.3% (95% CI, 8.0%–10.6%; design effect, 2.1). Prevalence estimates were similar in men and women. The prevalence of visual impairment and blindness increased rapidly with age (Fig 1). Using World Health Organization estimates for the prevalence of blindness (i.e., assuming that the prevalence of blindness in those younger than 15 years was 0.124% and that in those 15–49 was 0.2%),[1] the population prevalence of blindness was 0.3%. However, if we assume that 80% of blindness is in people over 50,[1] then the population prevalence of blindness was 0.1%. The true population prevalence may lie within this interval.

There were 77 people who were pseudophakic or aphakic in both eyes, and 71 had unilateral (pseudo)aphakia. Men and women were equally likely to have (pseudo)aphakia. Of those in the examined sample, 2.5% wore spectacles.

Cataract was the primary cause of bilateral blindness (42.0%) and bilateral visual impairment (36.0%) (Table 4). Posterior segment disease (including glaucoma, diabetic retinopathy, and age-related macular degeneration [AMD]) accounted for 30.4% of bilateral blindness and 24.1% of bilateral visual impairment. Two thirds (66%) of the 119 cases of posterior segment disease were classified broadly as posterior segment/CNS disorder; 19%, glaucoma; 13%, AMD; and 2%, diabetic retinopathy. Refractive error made up almost a third of cases of bilateral visual impairment (31.5%) but only 4.3% of cases of blindness. Avoidable causes—that is, cataract (including unoperated and postoperative complications), refractive error, trachoma, and other causes of corneal scars—were responsible for 69.6% of bilateral blindness and 74.9% of bilateral visual impairment.

Extrapolating survey data to the age and gender distribution of Nakuru district,[5,6] in ≥50-year-olds there were estimated to be 574 blind men and 499 blind women, 691 severely visually impaired men and 488 severely visually impaired women, and 1988 visually impaired men and 1866 visually impaired women (Table 5). The age- and gender-adjusted prevalence of blindness was 1.2% (95% CI, 0.8%–1.7%); that of severe visual impairment, 1.3% (95% CI, 0.9%–1.8%); and that of visual impairment, 4.3% (95% CI, 3.4%–5.3%).

Cataract surgical coverage was consistently high for both people and eyes (Table 6). Almost 8 of 10 people needing surgery at VA<3/60 had received surgery, and for eyes with cataract at VA<6/60, cataract surgical coverage was 48.3%. Eighty-six people in the sample wore spectacles, compared with 219 people who needed spectacles for distance correction (people with spectacles plus people with uncorrected refractive errors), giving a coverage of 39.3%.

More than half of the surgeries were undertaken in government hospitals (56.4%), the remainder taking place in volunteer/charity hospitals (19.8%), in private hospitals (16.7%), or in eye camps (7.0%). Outcome after surgery was relatively poor (Table 7). With available correction, only half of eyes (49.5%) had a good outcome (VA≥6/18) after surgery, 19.8% had a borderline outcome

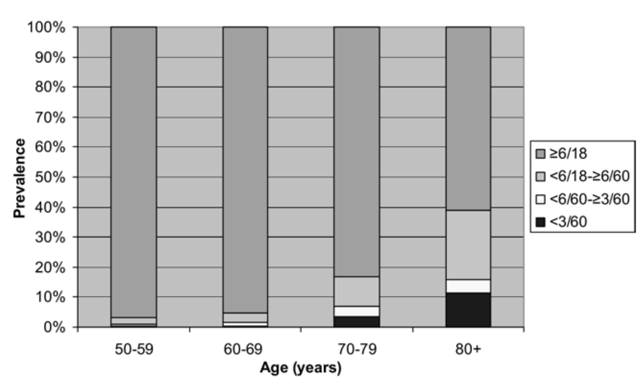

Figure 1. Prevalence of visual impairment by age in Nakuru district, Kenya.

Table 4. Cause of Bilateral Blindness (Visual Acuity [VA] < 3/60) and Bilateral Visual Impairment (VA<6/18–≥6/60) in Those with Available Correction

	Bilateral Blindness (VA<3/60) (n = 69)	Bilateral Severe Visual Impairment (VA<6/60–≥3/60) (n = 54)	Bilateral Visual Impairment (VA<6/18–≥6/60) (n = 203)
Refractive error	3 (4.3%)	4 (7.4%)	64 (31.5%)
Cataract, untreated	29 (42.0%)	27 (50.0%)	73 (36.0%)
Aphakia, uncorrected	4 (5.8%)	4 (7.4%)	1 (0.5%)
Cataract surgical complications	2 (2.9%)	1 (1.9%)	4 (2.0%)
Trachoma	4 (5.8%)	0	1 (0.5%)
Other corneal scar	4 (5.8%)	2 (3.7%)	9 (4.4%)
Phthisis bulbi	2 (2.9%)	0	0
Posterior segment	21 (30.4%)	16 (29.6%)	49 (24.1%)
Globe abnormalities	0	0	2 (1.0%)
Avoidable blindness	48 (69.6%)	38 (70.4%)	152 (74.9%)

(<6/18–6/60), and 30.6% had a poor outcome (<6/60),[16] although this improved with correction. Good outcome (with available correction) was more likely if the surgery was with an IOL (OR, 4.0; 95% CI, 2.2–7.3), in the last 5 years (OR, 2.6; 95% CI, 1.5%–4.6%), or undertaken in a volunteer/charity hospital or private hospital rather than the government hospital or eye camp (OR, 2.1; 95% CI, 1.2–3.8). The cause of poor outcome in people was approximately equally likely to be uncorrected refractive error (33.9%), surgery-related complications (30.4%), or a concurrent cause of blindness (35.7%). Satisfaction with surgery was reported by 147 of 148 respondents who had undergone surgery, of whom 94 were very satisfied, 28 were somewhat satisfied, 7 were indifferent, and 18 were somewhat or very dissatisfied.

Those with a cataract causing a VA of <6/60 in the better eye were asked why they had not gone for surgery. The most common reasons were "not aware of surgery" (34.1%), "cannot afford the operation" (24.4%), and "no one to take me" (12.2%).

The RAAB took 5 weeks of fieldwork and cost approximately $22 500 (3 teams, 5 weeks of fieldwork working 5 days per week and 1 week of training). The survey cost could have been reduced by approximately $5000 if each team had consisted of one ophthalmologist or ophthalmic medical officer with one nonmedical assistant, rather than 2 trained clinicians. Each team could complete one cluster of 50 people 50 years or older per day. The software was easy to use, and each data entry clerk required only 1 day of training.

Discussion

Avoidable Blindness

Vision 2020: The Right to Sight was launched in 1999 with the goal of eliminating avoidable blindness by 2020. The concept of avoidable blindness combines those diseases that are either easily preventable or treatable. The RACSS has been used and reported by several countries.[2–8] The RACSS methodology has been adapted and used for the first time in this survey to assess the prevalence of avoidable blindness, not only cataract, using new data entry and analysis tools.

Experience with Rapid Assessment of Avoidable Blindness and Sampling

Compact segment sampling was used to select households. This is preferable to the random walk method, which lacks objectivity in household sampling.[17] In many of the clusters, the households were very spread out, so sampling households through a random walk would have been logistically difficult. The compact segment sampling method is also statistically more sound, with higher precision and a lower risk of bias.[14] The proportion of those who refused or were absent was low, although the level of participation may have been overestimated due to incomplete recording of those absent. The sampling frame for the survey was electoral role data rather than census data, as the latter were not sufficiently recent. There are concerns that electoral role data could be manipulated (e.g., by bringing in voters from elsewhere to increase votes for particular candidates). This rarely occurs in residential or rural areas, however, as the locals will recognize the intruders as being foreign. There were 2 commercial centers in Nakuru where this may have happened, but these were not included in our sampling frame, as there were no residents.

Table 5. Estimated Burden of Blindness and Visual Impairment

	Male (n = 44 519)		Female (n = 44 195)		Total (n = 88 714)	
VA with Available Correction	*n*	*Prevalence (95% Confidence Interval)*	*n*	*Prevalence (95% Confidence Interval)*	*n*	*Prevalence (95% Confidence Interval)*
<3/60, bilateral blindness	574	1.3% (0.6%–2.0%)	499	1.1% (0.5%–1.7%)	1073	1.2% (0.7%–1.7%)
<6/60–≥3/60, bilateral severe visual impairment	691	1.6% (0.9%–2.3%)	488	1.1% (0.6%–1.6%)	1179	1.3% (0.9%–1.7%)
<6/18–≥6/60, bilateral visual impairment	1988	4.5% (3.2%–5.8%)	1866	4.2% (3.0%–5.4%)	3854	4.3% (3.3%–5.3%)
Bilateral aphakia/pseudophakia	607	1.4% (0.7%–2.1%)	717	1.6% (0.9%–2.4%)	1323	1.5% (1.0%–2.1%)
Unilateral aphakia/pseudophakia	798	1.8% (1.1%–2.5%)	515	1.2% (0.5%–1.9%)	1313	1.5% (1.0%–2.0%)
Aphakic/pseudophakic eyes	2011	2.3% (1.5%–3.2%)	1949	2.2% (1.4%–3.0%)	3960	2.2% (1.6%–2.9%)

VA = visual acuity.

Prevalence of Visual Loss

The sample prevalence of blindness (VA<3/60 with available correction) in ≥50-year-olds in this study was 2.0% (95% CI, 1.5%–2.4%), and prevalence of visual impairment (VA of <6/18–6/60) was 5.8% (95% CI, 4.8%–6.8%). These were similar in men and women. The prevalence of blindness was assessed only in those 50 or older; however, the prevalence is low in those under 50.[1] The prevalence of blindness in Nakuru is lower than expected, based on studies using the RACSS methodology in other countries[4–9] and previous reports from Africa. Two previous Kenyan surveys reported a population prevalence of blindness of approximately 1%,[10,11] and the estimates of blindness for Africa suggest that 9% of ≥50-year-olds are blind.[1] The previous surveys in Kenya were carried out more than 15 years previously,[10,11] and in the intervening time, presumably, the availability of cataract surgical services and other eye care services improved.[18] This is exemplified by the very high cataract surgical coverage observed in this survey.

The population in our sample was older than expected based on the Kenya census results, so it is unlikely that our low prevalence estimates were due to selection bias in the sample. Previous surveys mainly used the random walk method to select houses, and because village guides are often aware of who in the village are blind and where they live, they may skew sampling of households towards those with blind people, resulting in an overestimated prevalence. In our study, we used the compact segment method and visited households door to door, rather than asking people to come to a central place, to increase further the representativeness of the sample.

Causes of Visual Loss

Cataract was the major cause of blindness (42%). This is similar to the other reported studies from Kenya and the current global estimate.[1,10,11] Altogether, nearly 70% of all blindness was attributed to definitely avoidable causes—again, similar to the global estimates.[1] This does not include cases of glaucoma and diabetic retinopathy, which are potentially avoidable and classed as diseases of the posterior segment. The RAAB survey was designed to be rapid and field based to diagnose avoidable causes of blindness, so the ability to diagnose posterior segment causes of blindness accurately was low. The diagnosis of refractive error depended on the accuracy of measurement of VA and did not allow differentiation between types of refractive error.

Table 6. Cataract Surgical Coverage (CSC) by Person and Eyes in Those ≥50 Years Old (Best Correction)

	CSC	
VA Category	*Person (95% Confidence Interval)*	*Eyes (95% Confidence Interval)*
<3/60		
Male	78.3% (65.5%–87.5%)	54.8% (47.6%–61.9%)
Female	77.6% (65.5%–86.5%)	53.7% (46.8%–60.4%)
Total	78.0% (69.6%–84.6%)	54.2% (49.3%–59.1%)
<6/60		
Male	69.4% (57.3%–79.5%)	47.6% (41.0%–54.3%)
Female	72.2% (60.2%–81.8%)	48.9% (42.5%–55.5%)
Total	70.8% (62.6%–78.0%)	48.3% (43.7%–52.9%)
<6/18		
Male	51.0% (41.0%–60.8%)	35.4% (30.1%–41.1%)
Female	50.9% (41.3%–60.4%)	35.8% (30.6%–41.3%)
Total	50.9% (44.1%–57.7%)	35.6% (31.9%–39.5%)

VA = visual acuity.

Table 7. Postoperative Visual Acuity in 222* Eyes after Cataract Surgery, by Intraocular Lens (IOL) Status

	Non-IOL Eyes (n = 93)	IOL Eyes (n = 129)	All Eyes (n = 222)
Available correction			
Can see 6/18	28 (30.1%)	82 (63.6%)	110 (49.5%)
Cannot see 6/18, can see 6/60	22 (23.7%)	22 (17.1%)	44 (19.8%)
Cannot see 6/60	43 (46.2%)	25 (19.4%)	68 (30.6%)
Best correction			
Can see 6/18	39 (41.9%)	102 (79.1%)	141 (63.5%)
Cannot see 6/18, can see 6/60	27 (29.0%)	5 (3.9%)	32 (14.4%)
Cannot see 6/60	27 (29.0%)	22 (17.1%)	49 (22.1%)

*There were missing data for 3 aphakic eyes.

Cataract Services

Cataract surgical coverage was higher than previously reported in Africa, at nearly 50% for eyes with VA<6/60,[19–21] and coverages were similar for men and women. This demonstrates that cataract services are available to the majority of the population in this area of Kenya and that community uptake is reasonably good. The main reasons for poor uptake were lack of awareness and cost. Outcome after surgery was a concern because approximately 22% of the 222 eyes that had undergone cataract surgery had a poor outcome with best correction (VA<6/60).[16] Implementing a monitoring system for cataract surgical results could sensitize surgeons to quality control, thereby improving outcomes after surgery.[22–25] Provision of spectacles after surgery, improved follow-up after surgery, and better selection of patients for surgery also will improve outcomes.

The RAAB methodology is easy to use and inexpensive and provides useful information for planning and monitoring the impact of eye care services. The prevalence of blindness in Nakuru was lower than expected, probably because of the high cataract surgical coverage. The RAAB's results suggest that providing high-quality cataract services in Africa could lower the prevalence of blindness to levels similar to those of industrialized countries. This provides additional support for the importance of Vision 2020: The Right to Sight.

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