Prevalence and causes of blindness in the Northern Transvaal

PIUS J M BUCHER¹ AND CAREL B IJSSELMUIDEN²

From the ¹Department of Ophthalmology, Elim Hospital, and the ²Department of Community Health, University of the Witwatersrand, Johannesburg and Elim Hospital, South Africa

SUMMARY During November 1985 a survey was carried out to determine the prevalence and causes of blindness in the Elim Hospital district of Gazankulu in the Northern Transvaal, South Africa, and to assess the Eye Department's effectiveness in preventing blindness. Using a random cluster sample technique, we screened 18 962 of the estimated 71 200 inhabitants of the district (26.6%). We found 109 blind people. The prevalence of blindness was 0.57% (95% confidence interval 0.46%–0.68%). The main causes of blindness were senile cataract (55%), corneal scarring due to trachoma (10%), uncorrected aphakia (9%), and open-angle glaucoma (6%). There were 14 aphakic blind persons who did not have aphakia glasses (43% of all persons operated on for cataract). Women had a significantly higher prevalence of blindness than men. After the age of 60 years the prevalence of blindness increased sharply. Women were 1.6 times less likely to have undergone cataract surgery than men. The two most effective steps to reduce the prevalence of blindness in the Elim district further are to provide aphakia glasses to all aphakic patients and to improve the accessibility of the Eye Department's surgical services.

The district served by the Elim Hospital is part of the Gazankulu 'homeland'. It is situated in the far northern part of the Transvaal Province of South Africa, just north of the tropic of Capricorn at an altitude of approximately 600 m above sea level. The summers are hot and winters are cool. The average rainfall is approximately 500 mm per year, 80% of which falls in the summer months.¹

The Elim district's population is approximately 71 200 people.¹² The rate of natural increase is an estimated 3.0%, and 53.6% are younger than 15 years of age. Only 3.5% of the population are 65 years of age or older.¹ Owing to the migrant labour system over 70% of men in the economically active age groups are absent for most of the year.³

The population of the Elim district live in 21 well defined villages. Motorised transport is available but expensive. Water is scarce and must be collected from communal standpipes or rivers. The average cash income for a family of four persons is estimated at R50–150 per month. (The price of a month's supply of maize meal, the local staple food, is R40.) There is early and late childhood malnutrition, while

there is no (anthropometric) undernutrition in adults.⁴⁵ It is estimated that 40% of women and 60% of men over the age of 20 years are literate.¹

The ophthalmic services at the Elim Hospital have a long history.⁶ The Ophthalmic Hospital at Elim is sufficiently equipped to deal with the diagnosis and treatment of most common eye conditions. Lid and orbit operations as well as extra and intraocular operations of the anterior segment can be performed.

The Elim Blindness Prevention Programme was started in 1972, and it consists of three interrelated activities. Preventive and promotive care is mostly provided by the volunteer Care Group (CG) members in all villages of the Elim Health Ward.⁷ Curative care is given in the Eye Hospital and the mobile clinics by ophthalmologists and ophthalmic nurses. Rehabilitation is provided by an occupational therapist and a mobility trainer.⁸⁹

Most information on the occurrence of blindness in Africa is based on hospital record reviews.^{10 11} Hospital data are not likely to be representative of the pattern of eye diseases in a population, since geographical, cultural, socioeconomic, and political factors may all influence hospital usage.¹¹

Available data on blindness in the Northern

Correspondence to Pius J M Bucher, MD, Augenspital, Mittlere Strasse 31, CH-4056 Basel, Switzerland.

Transvaal is also limited. Earlier studies either were done more than 30 years ago^{12,13} or were concerned only with a specific cause of blindness,¹² or were only hospital based.⁹ Extrapolating from hospital records, Sutter estimated that blindness prevalence in the Northern Transvaal was 1.5–2.0%.^{8,9}

The purpose of this study was to assess accurately the prevalence and causes of blindness in the Elim Health Ward. A secondary aim was to develop a hypothesis regarding the relation between the surgical activities of Elim's Eye Hospital and the prevalence of blindness in the Elim Health Ward. This last aim would have to be achieved without the availability of baseline data and without reference to a control area owing to the absence of prior community based research and lack of resources respectively. This study was conducted during November 1985.

Population and methods

Seven of the 21 villages in the Elim district (Fig. 1) were randomly selected, and all permanent residents

Fig. 1 Composite map of the Elim district. Study villages are indicated with solid dots.

(that is, excluding migrant workers) were included in the study sample.

In the first stage of this survey CG members visited all houses in the seven selected villages. They checked the vision by asking people to count fingers at a distance of five large steps (this is always more than 3 meters) with both eyes open, wearing their own glasses (if any), outdoors in daylight. They also asked for persons who had had eye operations and for young children with 'problems of vision'. The names of all people who failed the finger counting test or had had eye surgery, and the names of all children with suspected vision problems, were recorded. Persons not present at the time of the CG member's visit were to be revisited on at least one occasion.

During the six weeks prior the survey the CG members were trained by hospital staff. Their competence was assessed by means of role plays. During the survey the CG members were supervised on a part-time basis.

In the second stage of the survey two to four days after completion of the screening the ophthalmic team (OT) visited the selected villages. The OT comprised an ophthalmologist, two ophthalmic nurses, a care group motivator, and an ambulance driver, and was based at a local school or clinic. To increase coverage further all local officials (teachers, headmen, clinic sisters, and community health workers) were also informed about the survey and were requested to bring anyone with suspected vision problems to the OT. All recorded, referred, and 'self-reporting' persons were screened by the OT. Persons whose names were recorded but who were not present at the time of the OT's visit were traced one or two days later. People who were not able to come to the OT were examined at their homes.

In this second screening phase people unable to count fingers at a distance of 3 meters (equivalent to visual acuity 3/60) or less were identified as blind.^{14,15} These, together with all persons who had had an operation, constituted the final study group. Their personal and ophthalmic history was taken, and their socioeconomic status was assessed. The subject's visual acuity was tested for each eye, with and without correction, by Snellen charts. The anterior segment was examined with a torch and 5 times magnifying binocular glasses. The posterior segment was examined by direct ophthalmoscopy, and the intraocular pressure measured by Schiøtz tonometry. The visual acuity of aphakic eyes was determined with standard spheric correction, that is, +10, +11, or +12 dioptres.

Glaucoma was diagnosed by an intraocular tension above 21 mmHg and a glaucomatous excavation of the papilla. Owing to the limitations of the examination methods employed under field conditions we

could differentiate only between open-angle (deep anterior chamber), narrow-angle (shallow anterior chamber, clinical signs of acute glaucoma attacks), and secondary glaucoma (trauma, cataract operation).

Classification of blinding diagnoses was done as recommended by the WHO.^{14 15} The most probable cause of blindness for each eye was established as recommended by the National Society for the Prevention of Blindness in the USA.¹⁶ Persons who had different causes of blindness for each eye were classified according to the most recent eye becoming blind.^{16 17}

For reasons indicated in the discussion the study sample was treated as if it was the result of a random sampling procedure. The effects of clustering were therefore not taken into consideration when statistical calculations were done. Differences between two proportions were assessed by the standard formula. To assess differences in overall blindness prevalence in males and females, age adjusted rates were calculated from the total study sample as standard population. However, the male-female prevalence difference is not constant in all age groups, and the age adjusted rates are therefore only a crude measure of true prevalence.

In this article we differentiate between 'refractive' blindness, which is treatable by proper correction of the refractive error, and 'non-refractive' blindness, which includes all other causes of blindness. Effective blindness includes both 'refractive' and 'non-refractive' blindness.

Results

The estimated population of the seven selected villages combined was 18 962 persons, which is 26.6% of the total population of the Elim district.

The number of people identified by the CG members was 281, of whom 270 (96%) or more (some might have used other names) were subsequently seen by the OT. An additional 151 persons were referred by village officials or were self-reporting.

In total 172 people were included in the final study group, of whom 138 (80%) were identified by the CG. Of the 172 study subjects 109 were blind and 63 were not blind but had had an eye operation.

The prevalence of effective blindness in the Elim district was 0.57% (95% confidence interval 0.46%–0.68%). The prevalence of 'non-refractive' blindness alone was 0.50% (95% confidence interval 0.40%–0.60%).

Women were significantly more affected by blindness than men ($p < 0.0001$) (Table 1). The prevalence of blindness rose sharply after the age of 60 years in both sexes (Table 1). The average age of blind persons was 69.4 years (SD 15.3 years). The difference in the average age between males (65.2 years, SD 22.3 years) and females (71.1 years, SD 11.6 years) was not statistically significant.

The most common causes of bilateral blindness in the Elim district were senile cataract (55%), corneal scarring due to trachoma (10%), uncorrected aphakia after cataract surgery (9%), and open-angle glaucoma (6%) (Table 2). No proper diagnoses and

Table 1 Distribution of population and blindness by age and sex

Age group	Population Elim Health Ward*				Blindness					
	Sex (%)		Total		Cases			Prevalence (%)		
	Males	Females	n	(%)	Males	Females	Total	Males	Females	Total
0–4	9.9	10.3	14377	20.2	1		1	0.05		0.03
5–9	9.1	9.1	12953	18.2						
10–14	7.6	7.6	10817	15.2	1		1	0.07		0.03
15–19	4.2	5.4	6830	9.6		1	1		0.10	0.06
20–24	1.6	4.7	4481	6.3	1		1	0.33		0.08
25–29	1.1	4.5	3982	5.6						
30–34	0.9	3.4	3057	4.3						
35–39	0.9	3.0	2772	3.9	1	1	2	0.60	0.17	0.27
40–44	0.8	2.4	2273	3.2	1		1	0.64		0.16
45–49	0.9	2.3	2273	3.2						
50–54	0.7	1.8	1775	2.5	1	3	4	0.69	0.89	0.83
55–59	0.7	1.7	1704	2.4	1	1	2	0.73	0.32	0.44
60–64	0.6	1.4	1419	2.0	1	8	9	0.85	3.18	2.43
65–69	0.5	0.8	921	1.3	4	16	20	4.23	10.91	8.31
70–74	0.4	0.6	707	1.0	4	16	20	5.60	12.78	10.14
75+	0.4	0.8	849	1.2	14	33	47	16.42	22.33	20.15
Total	40.5	59.5	71190	100.0	30	79	109			
Crude blindness prevalence								0.39	0.70	0.57
Age adjusted blindness prevalence								0.44	0.64	

*Excluding migrant workers. Institute of Development Studies.¹

Table 2 Aetiology of blindness

Aetiology: WHO code, clinical entity	Males	Females	Total	Percentage of all blindness
Infection				
271.0 Corneal scar (trachoma)	1	10	11	10.09
369.0 Undefined blindness (both eyes) (trachoma)		1	1	0.92
Injury				
365.6 Secondary glaucoma (trauma)		1	1	0.92
377.1 Optic nerve atrophy (trauma)	1		1	0.92
369.0 Undefined blindness (both eyes) (trauma)	1	1	2	1.83
Neoplasm				
Systemic				
271.0 Corneal scar (vitamin A deficiency)	2	1	3	2.75
Degeneration				
371.4 Corneal, degeneration (cataract operation)		1	1	0.92
371.6 Keratoconus		1	1	0.92
366.1 Senile cataract	13	47	60	55.05
379.3 Aphakia (dislocation of the lens)		1	1	0.92
379.3 Aphakia (cataract operation)	4	6	10	9.17
363.4 Choroid degeneration	1	1	2	1.83
362.5 Drusen maculopathy	1		1	0.92
365.1 Open-angle glaucoma	4	3	7	6.42
379.2 Vitreous opacities (cataract operation)		2	2	1.83
Prenatal influence				
743.1 Microphthalmos	1		1	0.92
Cause not known				
360.4 Phthisis bulbi		1	1	0.92
271.0 Corneal scar	1		1	0.92
377.1 Optic nerve atrophy		1	1	0.92
369.0 Undefined blindness (both eyes)		1	1	0.92
Total	30	79	109	100

aetiology could be established in four persons (4%). In 41 blind persons (38%) a different aetiology in each eye was found. The relative importance of the causes of blindness was not affected by classification on eyes as compared with classification on persons.

The difference in prevalence of senile cataract between men and women was not statistically significant ($p=0.14$). Men were 1.6 times more likely to have been operated on for cataract ($p=0.0455$). Only 37% of persons blinded by senile cataract were operated on (Table 3). Blindness due to trachoma was virtually confined to women over the age of 65

years. Of all persons operated on for entropion 92% were women. The prevalence of blindness and the number of operations due to glaucoma was similar in males and females.

There were 17 study subjects who had had a cataract operation and were not blind, 14 with a previous entropion operation and seven with a previous glaucoma operation who were not blind in the operated eye but blind in the other eye. On the assumption that at the time of the survey these persons would have been blind without operation the total number of blind persons in our study sample would have been 147 and the blindness prevalence 0.77% (95% confidence interval 0.64%–0.90%). Compared with the actual blindness prevalence the effect of the ophthalmic surgical activities on the non-refractive and effective blindness prevalence in the Elim area has at best been a reduction of 26% and 35% respectively.

However, on the assumption that at the time of this study all persons at present blind from senile cataract, entropion (trachoma), and glaucoma would not have been blind if they had had eye surgery, the number of blind persons in our sample would have been only 20. The blindness prevalence would then have been 0.11% (95% confidence interval 0.06%–0.16%). Therefore only 30% of cases of blindness

Table 3 Distribution of blinding senile cataract and aphakia

	Males (n=26)	Females (n=64)	Total (n=90)
Not operated on	13 50%	44 69%	57 63%
Operated (aphakic)	13 50%	20 31%	33 37%
Blind (with glasses)	0 0%	3 5%	3 3%
Not blind with glasses	11 42%	13 20%	24 27%
Have no glasses*	4 15%	9 14%	13 15%
Have own glasses	7 27%	4 6%	11 12%
Not blind without glasses	2 8%	4 6%	6 7%

*Three of these persons were classified with another cause of blindness than aphakia.

which could have been prevented or cured by an ophthalmic operation were in fact reached.

Discussion

To obtain reliable estimates of the blindness prevalence in the Elim population 18962 people were screened. The screening of such a large number of people with only a few health professionals was possible only with the help of volunteer health workers (CG). The time and organisation needed to prepare them adequately for this survey forced us to keep the number of clusters to a minimum. Since the Elim district is relatively homogeneous in respect of population, geography, income distribution, and provision of health services, we do not think that the small number of clusters will compromise the results of the study. The results of this study are therefore probably representative of the whole Elim district.

The preparation time given to the CG was only six weeks, which is a relatively short time in the local context. In spite of this they identified 80% of all people included in this study. We cannot be certain how many blind people were not seen by the OT. We can only presume that the CG did visit all homes in their village and made follow-up visits to contact absentees. The respectability of the CG and the local health service in general make it unlikely that many blind persons were missed. Although the results of this study should technically be considered as 'minimum-estimates', we think that they are in fact a fair representation of the actual situation in the Elim district.

The blindness prevalence in the Elim district is lower than the prevalence in most other subSaharan African countries.¹⁸⁻²² Differences in methodology between these studies and complete absence of onchocerciasis (in some African countries responsible for 12%-37% of all cases of blindness¹⁰) may partly explain this.

Blindness affects mainly those above 60 years of age, especially women. The excess risk of blindness

in women is largely explained by blinding trachoma and untreated senile cataract. The reasons why blinding trachoma affects mostly women have been discussed earlier.⁹ The lower literacy rate in women may explain the higher proportion of untreated senile cataract in women. The slightly higher average age of women may also be an explanation for the higher prevalence of degenerative diseases and diseases depending on repeated exposure to a noxious influence or agent.

In 1973 a hospital based blindness study was done in the Elim area.⁹ The one notable difference between causes of blindness in 1973 and 1985 is glaucoma (Table 4). The completely different methodology of the two studies might be the reason for this.

A surprise finding was that uncorrected aphakia after cataract surgery was the third most common cause of blindness. The reasons for this were not studied, but several factors might play a part, such as loss of glasses, inability to afford glasses, reasonable vision by the second eye at the time of first cataract surgery, or no need for glasses because of illiteracy and life style. To our knowledge it has not been reported earlier that uncorrected aphakia is a major cause of blindness. However, noting the similarities in health and health services between the Elim district and other third world areas, we would speculate that this cause of blindness may not be limited to the Elim district alone.

Surgical interventions by Elim Hospital's Eye Department have probably reduced blindness prevalence, but the effectiveness is low. One explanation might be the relative inaccessibility of the Eye Hospital's services. Geographical, economic, social, cultural, and political (borders) factors may all contribute to the inaccessibility.²³ The exact causes will have to be studied carefully, since it is clear from this study that the most significant contribution of Elim Hospital's Eye Department to the Blindness Prevention Programme in the short term is to operate on a much greater proportion of those people blinded by senile cataract and to provide aphakia glasses to all aphakic persons.

Table 4 List of five main causes of blindness in Elim district 1973 and 1985

1973* Hospital based data		1985 Population based data	
Diagnosis	%	Diagnosis	%
Cataract	50	Cataract	55
Glaucoma	19	Trachoma	10
Trachoma	7	Aphakia/no glasses	9
Leukoma-staphyloma	5	Glaucoma	6
Corneal degeneration	3	Corneal scar (vitamin A deficiency)	3

*See Sutter.⁹

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