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## Cataract blindness in Paraguay – results of a national survey

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### Abstract

**PURPOSE** To estimate the burden of visual loss and blindness due to cataract in people aged 50 years and over in Paraguay.

**METHODS** Forty clusters of 60 persons each who were 50 years and older (2400 eligible persons) were selected by systematic random sampling from the entire population of Paraguay. A total of 2136 persons were examined (89% coverage).

**RESULTS** For the population 50 years and over, the age- and gender-adjusted prevalence of bilateral blindness (VA < 3/60 with available correction) was 3.14% (95% CI: 2.2–4.4). The adjusted prevalence of bilateral cataract blindness (VA < 3/60) was 2.01% (95% CI: 1.3–3.0), making cataract the major cause of bilateral blindness in this age group (64%). The adjusted prevalence of bilateral severe visual impairment (VA < 6/60 with available correction) was 5.17% (95% CI: 3.9–6.7) and the adjusted prevalence of severe visual impairment due to bilateral cataract (VA < 6/60) was 3.09% (95% CI: 2.2–4.3).

The cataract surgical coverage (persons) was 44% for bilaterally blind persons with VA < 3/60; 36% for persons with bilateral VA < 6/60; and 28% for any eye with VA < 6/60 due to cataract.

With IOL implantation, 77% of the operated eyes could see 6/18, against 46% of the non-IOLs ( $p < 0.005$ ), a significant better outcome.

**CONCLUSION** There is a need to increase the cataract surgical coverage in Paraguay. The number of eye surgeons is adequate but the

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accessibility of cataract surgical services in rural areas and the affordability of surgery to large sections of society are major constraints.

**Key words** Cataract prevalence; cataract surgery; blindness prevalence; population survey; Paraguay

**Introduction** Age-related cataract remains the major cause of visual impairment and blindness in most countries. A declining birth rate and increased life expectancy is resulting in a sharp increase in the number of people of 50 years and older. In many countries this has caused an increase in the prevalence of cataract blindness and a greater demand for cataract surgical services.

Paraguay lies in the centre of South America, sharing borders with Bolivia (north), Brazil (east) and Argentina (south and west). The 1992 national census of Paraguay reported a total population of 4.153 million people, of which 507,486 people were 50 years or older (12.22%).<sup>1</sup> The population in 1999 is estimated at 5.4 million, giving a population density of 14 persons per square kilometre. However, most cities and towns are concentrated in the southern third of the country while the northern and western two-thirds form the arid wilderness of the Chaco; 95% of the population is mestizo (mixed Spanish and Guarani Indians). The population growth is 2.6% annually and life expectancy at birth 71.4 years for males and 76.5 for females. The literacy rate, defined as all people of 15 years of age or older that completed at least the second year of primary education, is 90.6% (1995 estimate).<sup>1</sup> The per capita GDP in the year 2000 is estimated at US\$ 4,750. Approximately 36% of the population have an income not enough to provide for basic healthy food, health services, housing and education.<sup>2</sup>

There are an estimated 140 ophthalmologists in Paraguay, an average of 1 per 40,000 people. Approximately 90% are located in or close to Asuncion. Most of the ophthalmologists work exclusively in the private sector. A few ophthalmologists give some of their time to work in the government or university sectors. There is no training programme for ophthalmic nurses or optometrists. Primary eye care activities are implemented through Health Promoters and general medical staff.

Approximately 3500 cataract operations are performed each year in Paraguay giving an estimated cataract surgical rate of 650 cataract surgeries per million population. Assuming that half of the 140 ophthalmologists are surgically active, this would mean an average of one cataract operation per surgeon per week. The proportion of IOL implants is not known.

**Methods and materials** No population-based survey on blindness has been conducted before in Paraguay. Local ophthalmologists estimate the prevalence of blindness (VA < 3/60 with available correction) to be around 0.6% in the total population, of which 60% is estimated to be due to cataract. The prevalence of bilateral cataract blindness is thus estimated at 0.36%. Assuming that senile cataract only occurs in people of 50 years and older, the prevalence of cataract blindness in persons 50+ in Paraguay is estimated to be 3.0%.

Because of the scattered rural population and the limited human resources for fieldwork, it was decided to examine 40 clusters of 60 persons of 50 years and older. Earlier studies from similar surveys indicated a design effect of 1.7 for a cluster size of 60.<sup>3</sup> Allowing for a precision of  $\pm 30\%$ , with a confidence of 95%, a design effect of 1.7 and using a systematic cluster sampling methodology, the required sample size was calculated as 2,340.

Computerised census data from 1992 were used to create a list of settlements and their respective populations, adding a column with the cumulative population. The total population was then divided by the number of clusters to get the sampling interval. The first cluster was selected by multiplying the sampling interval with a random number between 0 and 1. The resulting number was traced in the cumulative column and the corresponding settlement was the settlement from which the first cluster was taken. Each of the following 39 clusters was found by adding the sampling interval to the previous number. This systematic random sampling procedure selects clusters with a probability proportional to the size of the population. This distribution of the clusters is shown on the map (Figure 1).

In each cluster, a two-stage sampling procedure is used. Houses were selected at random and within each house only men and women aged 50 years and older, residing in that house, were eligible for examination. The purpose of the study and the examination procedure were explained to the subjects and verbal consent was obtained before examination.

For the rapid assessment, a standardised protocol<sup>4</sup> was used. For each eligible person a standardised Survey Record was filled with six different sections: General information; Vision and pinhole examination; Lens examination; History, if not examined; Why cataract operation has not been done; and Details about cataract operation.

Visual acuity is measured with an 'E' chart with 6/18 (20/60) on one side and 6/60 (20/200) on the other side. The 6/60 is used at 6 or 3 metres distance. All measurements are taken with available correction in full daylight. If the VA is less than 6/18 in either eye, pinhole vision is also taken for each eye.

The WHO defines blindness as visual acuity (VA) less than 3/60 in the better eye with the best possible correction. A VA less than 6/60,

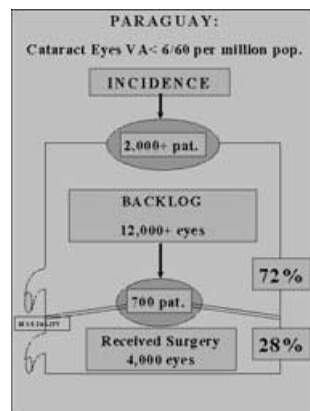


Fig. 1. Cataract eyes with VA < 6/60 per million persons in Paraguay.

but equal to or better than 3/60 in the better eye, is classified as severe visual impairment and a VA less than 6/18, but equal to or better than 6/60 in the better eye, is classified as visual impairment. Some patients may have more than one eye disorder causing visual impairment. We followed the WHO convention to assign the major cause to the disorder that is easiest to treat.

After measuring visual acuity, the examinee is taken inside the house, into a shaded or dark area. There, the lens status is assessed by torch and binocular loupe and by distant direct ophthalmoscopy at 20–30 cm distance in semi-dark condition, without dilatation of the pupil. The lens in each eye is examined and graded as ‘normal lens’, ‘obvious lens opacity present’, ‘lens absent (aphakia)’, ‘IOL implanted without posterior capsule opacification’ or ‘IOL implanted and posterior capsule opacification present’. If the lens cannot be seen because of corneal scarring, phthisis bulbi or other causes, ‘No view of lens’ is marked.

One or two teams of one ophthalmologist, one ophthalmic nurse and one enumerator can examine one cluster (60 persons) in one day. The population in each cluster was notified prior to the survey. However, if after repeated visits an eligible person was still not available, information about the subject’s visual status was collected from relatives or neighbours. Simple ailments were treated by the team. Patients with cataract, or those who required specialist treatment, were offered free services and given appointments.

A software programme for data entry and standardised data analysis has been developed in Epi-Info version 6.04. Data was double-entered to identify any errors. After data entry has been completed, the user selects the required level of vision ( $VA < 3/60$ ,  $VA < 6/60$  or  $VA < 6/18$ ) and then the required analysis report using the menu system. This report can be printed. The following standard reports can be produced:

- prevalence of all cause blindness and visual impairment;
- prevalence of cataract blindness and visual impairment;
- prevalence of aphakia and pseudophakia;
- cataract surgical coverage;
- visual outcome of cataract surgery;
- barriers to cataract surgery;
- age at surgery, place of surgery, type of surgery;
- use of glasses, reasons for not using glasses.

Further customised analysis is also possible using the analysis facilities of Epi-Info.

**Results** Of the total sample of 2400 persons aged 50 years and older, 2136 persons (89%) were physically examined: 987 males and 1149 females. Two-hundred-and-four eligible persons were not at home, even after repeat visits. Information about their visual status was obtained from relatives or neighbours, but this anecdotal data was not included in the analysis. All data from one cluster (60) was lost in transfer to the central data entry facility.

Out of the total 2136 examined persons, 76 (3.56%) were bilaterally blind ( $VA < 3/60$  with available correction) due to all causes. Of these,

Level of visual acuity	Males (n = 987)		Females (n = 1149)		Total (n = 2136)	
	Cases	Prev.	Cases	Prev.	Cases	prev. (95% CI)
Blindness (VA < 3/60 with available correction)						
All bilateral cases	32	3.24	44	3.83	76	3.56 (2.6–4.8)
Bilateral cataract cases	18	1.82	27	2.35	45	2.11 (1.4–3.1)
Eyes with cataract	62	3.14	94	4.09	156	3.65 (3.0–4.5)
Blindness + Severe visual impairment (VA < 6/60 with available correction)						
All bilateral cases	51	5.17	75	6.53	126	5.90 (4.7–7.4)
Bilateral cataract cases	26	2.63	42	3.66	68	3.18 (2.3–4.4)
Eyes with cataract	91	4.61	143	6.22	234	5.48 (4.6–6.5)
Blindness + severe visual impairment + low vision (VA < 6/18 with available correction)						
All bilateral cases	139	14.08	192	16.71	331	15.50 (13.5–17.7)
Bilateral cataract cases	40	4.05	62	5.40	102	4.78 (3.7–6.2)
Eyes with cataract	143	7.24	195	8.49	338	7.91 (6.9–9.1)
Bilateral aphakia	11	1.11	12	1.04	23	1.08 (0.6–1.9)
Unilateral aphakia	20	2.03	27	2.35	47	2.20 (1.5–3.3)
Pseudo(aphakic) eyes	42	2.13	51	2.22	93	2.18 (1.6–2.9)

45 persons (59%) were bilaterally blind due to cataract, giving a prevalence of 2.11%. Detailed results are given in Table 1.

The prevalence of blindness (due to cataract as well as to other causes) increases with age and is usually higher in females. When the age and gender composition of the sample differed from the actual population in the survey area, the prevalence rates from the sample were adjusted to reflect the true prevalence. The age and gender adjusted prevalence of all cause bilateral blindness (VA < 3/60 with available correction) in people of 50 years and older was 3.14% (95% CI: 2.2–4.4%), an estimated total of 15,958 people (see Table 2). Assuming that blindness (VA < 3/60) under the age of 50 is nil, the prevalence of all bilateral blindness (VA < 3/60 with available correction) in the entire population of 5.4 million (estimate 1999, at time of survey) would be 0.3%, 3000 cases per million population. As other total population-based surveys suggest that approximately 1 in 10 blind people are under 50 years of age,<sup>5</sup> the prevalence of blindness in the general population (all ages) was likely to have been around 0.33% in 1999.

The adjusted prevalence of bilateral cataract blindness in people of 50 years and older was 2.01% (95% CI: 1.3–3.0%), giving an estimated total of 10,213 patients or 1900 cases per million. Cataract was responsible for 64% of bilateral blindness. At the level of less than 6/60 vision, 54,816 eyes had cataract, around 10,150 cataract eyes per million population.

Patients who were blind or severely visually impaired due to cataract (42) were asked why they had not been operated so far. The major bar-

TABLE 1. Sample prevalence of blindness and cataract, by gender, in 2136 people aged 50 years and over.

TABLE 2. Age- and gender-adjusted results for the 50 years and over population of Paraguay.

	<i>Males</i> (age adjusted) (n = 245,184)		<i>Females</i> (age adjusted) (n = 262,305)		<i>Total</i> (age- and gender-adjusted) (n = 507,489)	
	<i>Cases</i>	<i>Prev.</i>	<i>Cases</i>	<i>Prev.</i>	<i>Cases</i>	<i>Prev. (95% CI)</i>
Blindness (VA < 3/60 with available correction)						
All bilateral cases	6,733	2.75	9,225	3.52	15,958	3.14 (2.2–4.4)
Bilateral cataract cases	4,366	1.78	5,847	2.23	10,213	2.01 (1.3–3.0)
Eyes with cataract	15,735	3.21	20,282	3.87	36,016	3.55 (2.9–4.4)
Blindness + Severe visual impairment (VA < 6/60 with available correction)						
All bilateral cases	10,514	4.29	15,701	5.99	26,216	5.17 (3.9–6.7)
Bilateral cataract cases	6,012	2.45	9,656	3.68	15,669	3.09 (2.2–4.3)
Eyes with cataract	22,465	4.58	32,351	6.17	54,816	5.40 (4.5–6.4)
Blindness + severe visual impairment + low vision (VA < 6/18 with available correction)						
All bilateral cases	29,231	11.92	41,206	15.71	70,437	13.88 (11.9–16.1)
Bilateral cataract cases	8,907	3.63	14,060	5.36	22,967	4.53 (3.4–5.9)
Eyes with cataract	32,980	6.73	43,276	8.25	76,256	7.51 (6.5–8.7)
Bilateral aphakia	2,362	0.96	2,414	0.92	4,775	0.94 (0.5–1.8)
Unilateral aphakia	4,588	1.87	5,815	2.22	10,403	2.05 (1.3–3.1)
Pseudo(aphakic) eyes	9,311	1.90	10,643	2.03	19,954	1.97 (1.43–2.66)

TABLE 3. Cataract surgical coverage (CSC) by persons and eyes in people aged 50+.

	<i>CSC – persons (95% CI)</i>	<i>CSC – eyes (95% CI)</i>
VA < 3/60	44 (29–59)	37 (29–46)
VA < 6/60	36 (24–49)	28 (22–36)
VA < 6/18	32 (22–43)	22 (17–27)

riers reported were “Don’t know where to go” (48%), “can see well, need not felt” (24%) and “cannot afford” (10%).

By comparing the number of (pseudo)aphakic persons, or eyes, with the number of cataract blind persons, or eyes, the Cataract Surgical Coverage could be calculated, the proportion of the cataract blind people, or eyes, that were provided surgical services.<sup>6</sup> This was calculated by gender and for various levels of visual loss, and gives an idea of the uptake of cataract surgical services by the population during the past. Six in ten bilaterally blind persons due to cataract (VA < 3/60) were not operated in either eye and seven in ten eyes with an acuity less than 6/60 due to cataract were not operated. The coverage rates for males were slightly higher, though not significant. The results are summarised in Table 3.

Visual acuity was measured in all aphakic or pseudophakic eyes in the sample (Table 4). It is important to realise that these cases include patients operated recently as well as many years earlier, by skilled as well as less skilled surgeons under optimal as well as less optimal con-

Category of visual acuity	IOL's		Non-IOL's		All eyes	
	eyes	%	eyes	%	Eyes	%
Can see 6/18	43	77	17	46	60	64
<6/18 – 6/60	7	12	1	3	8	9
<6/60	6	11	19	51	25	27
Totals	56	100	37	100	93	100

TABLE 4. Post-operative visual acuity in 93 eyes following cataract surgery, with available correction, and by IOL status.

ditions. Good results from recent surgeries could be outbalanced by less good results of operations conducted in the past.

With IOL implantation, 77% of the operated eyes could see 6/18, against 46% of the non-IOLs ( $p < 0.005$ ), a significantly better outcome. Results from operations during the previous 5 years were slightly better than from operations more than 5 years earlier. Unfortunately, there were no details on possible causes of poor outcome in this study. The non-IOL's may also have included uncorrected aphakics, failed IOL's and patients who lost vision due to other eye diseases.

Of all patients, 45% were operated on in government hospitals, 25% in private hospitals and 22% in non-governmental institutions. Treatment was provided free of cost to 20% of the cases, 40% paid part of the costs and another 40% paid everything.

**Discussion** The results represent averages for entire Paraguay. With a highly unequal distribution of the population as well as cataract surgical services, and a large proportion of the population with less access to eye care services, a stratified survey would have been more appropriate. However, this would have increased the sample size considerably, while human resources for this survey were limited.

Rapid Assessment of Cataract Surgical Services (RACSS) is not intended to replace a detailed blindness survey. It is a simple method to collect baseline data to facilitate adequate planning of cataract intervention programmes and to evaluate such programmes over time. With trained staff and adequate resources, the lens can be examined with portable slit lamp and dilated pupils. This may enhance the accuracy of the diagnosis.

The RACSS procedure has been used extensively in India<sup>7-9</sup> and a number of other countries like Vietnam, Turkmenistan,<sup>10</sup> Cambodia, Myanmar, Pakistan,<sup>11</sup> Mexico, Peru, and Mauritania.

The age- and gender-adjusted prevalence of bilateral cataract blindness in persons of 50 years or older was 3.14% (95% CI: 2.2-4.4%). Extrapolated to the total population this would give an age- and gender-adjusted prevalence for all bilateral blindness (VA < 3/60) of 0.30%, assuming all blind people are 50 years or above. As some blind people are under the age of 50 years, the true prevalence is likely to be closer to 0.33%.<sup>6</sup>

For every million people in Paraguay, at least 3000 are bilaterally blind and nearly 5000 people have a VA < 6/60 in the better eye. Of

these, approximately 3000 people are due to bilateral cataract, and over 10,000 eyes have a VA < 6/60 due to cataract per million population.

The Cataract Surgical Coverage for eyes varies from 37% for VA < 3/60 to 22% for VA < 6/18. This means that for every operated eye, three to four cataract eyes are in need of surgery. The small difference in coverage rates suggests that there is no particular threshold applied for cataract surgery in the country and patients with early cataract are operated while there is still a considerable backlog of more severe cataract. It may also suggest that availability, accessibility and affordability of cataract surgery are not yet optimal throughout Paraguay. Since this survey was not stratified, variation in prevalence by region or socio-economic background could not be determined.

Besides patient-related constraints there are also provider-related barriers to surgery. It is not clear how much the cost of surgery is a constraint. Paraguay is a large country with a low density of population. Few ophthalmologists work outside Asuncion, so distance and access to an ophthalmologist for examination and advice are likely to be significant barriers. With one ophthalmologist per 40,000 people, there should be sufficient capacity to increase the output.

Although most eye surgeons are private practitioners, nearly half of all operations were conducted in government hospitals, where most surgeries were free or against partial payment only.

The visual outcome after cataract surgery with available correction is in the same range as in other studies. Experience suggests that these outcome figures could be improved considerably with the provision of adequate optical correction.

## Conclusions

For each million people in Paraguay:

- there are an estimated 10,000 eyes (<6/60) needing cataract surgery (backlog);
- assuming the incidence of cataract blindness to be 20% of the prevalence, the incidence is conservatively estimated at 2000 eyes per year;
- there are 26 ophthalmologists;
- at present, 700 cataract operations are performed per year, of which approximately 1 in 10 has a poor outcome (<6/60) (see Fig. 2).

It is planned to use these findings in Paraguay to develop a National VISION 2020 programme, emphasising good quality cataract surgery with an IOL implant, made accessible to rural communities and affordable to all sectors of society.

Fig. 2. Paraguay: 40 clusters of 60 persons each, 50 years of age or older.



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