1

Review of recent surveys on blindness and visual impairment in Latin America

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ABSTRACT

Aims: To review recent data on prevalence and causes of blindness and visual impairment in Latin America.

Method: Data from recent population-based prevalence surveys in nine countries in Latin America, covering 30 544 people aged 50 years and older, are presented.

Results: The prevalence of bilateral blindness (VA <3/60 in the better eye with available correction) ranged from 1.3% in urban Buenos Aires, Argentina, to 4.0% in two rural districts of Peru; low vision from 5.9% in Buenos Aires to 12.5% in rural Guatemala. Cataract was the main cause of blindness (41–87%), followed by posterior segment disease (7–47%). Avoidable blindness ranged from 43% in urban Brazil to 94% in rural Guatemala.

Conclusions: 43% to 88% of all blindness in Latin America is curable, being caused by cataract and refractive errors. Simple and cost-effective intervention strategies exist and need to be made available to more people. Also, the visual outcome from cataract surgery can be improved. In the urban areas with adequate eye care services, blindness and low vision due to posterior segment disease are increasing. Results from these surveys may help planners to estimate the prevalence and causes of blindness in their own area or country.

Global estimates suggest that there are approximately 10.8 million people visually impaired, including 1.7 million blind in Latin America and the Caribbean, Cuba not included.[1] These estimates for Latin America and the Caribbean are based on eight population-based surveys, four of which were conducted at least 20 years ago. The survey areas were not randomly selected, covered different age groups and used different definitions of blindness and low vision.[2] Based on these data regional estimates were calculated for three subregions of the Americas, according to the Global Burden of Disease 2000 Project (table 1).[1]

Two other reviews of blindness and visual impairment in Latin America and the Caribbean mention three more studies.[3 4] Two of these were conducted in the period 1986–8 and one in 1992. The age groups varied from all ages to 40+, 50+ and 65+.

In 1999 Vision 2020—the Right to Sight, the joint initiative by the World Health Organization and the International Agency for the Prevention of Blindness to eliminate avoidable blindness by the year 2020 was launched.[5] The Vision 2020 strategy depends on the development of district-level plans to reduce avoidable blindness. Since 1999, nine population based surveys have been conducted in Latin America to provide baseline data for Vision 2020 action plans. The same data may also be useful and valid for other countries and regions that have not (yet) been in a position to assess the magnitude of the problem. According to recent information from WHO (personal communication) 11 out of the 20 countries in Latin America have already prepared a national Vision 2020 action plan.

In this review, the data from these nine recent surveys are presented and compared with findings from the earlier studies to assess trends. Results from five studies were published earlier, two studies are in press (Guatemala and Chile) and one study was presented as a postgraduate thesis (Cuba).[6–11] Results from Mexico are presented here.

METHODS

A standardised methodology for rapid population-based surveys on blindness and visual impairment, with emphasis on cataract (Rapid Assessment of Cataract Surgical Services, RACSS), was developed in 1998.[12] It uses a multistage cluster sampling methodology with a cluster size between 40 and 60, covering people aged 50 years or older, residing in the cluster. Clusters are selected from a sampling frame by systematic sampling and with a probability proportional to the size of the population. Households are selected by the "random walk" method. Any person living in a selected household for more than six months per year and aged 50 years or older is included in the study and examined. If a subject is absent, an appointment is made and the person is visited again. When a subject is absent for a longer period, or refuses to participate, a survey form is made for that person. Relatives or neighbours are asked to indicate the age and sex and whether the person is blind or not. Eligible people who are absent or who refuse to participate are not replaced because this may introduce bias. Data from non-responders are included in the number of eligible people but not in the data analysis.

Because in most countries 80% or more of all of blindness and visual impairment occurs in people aged 50 and older, the sample size is relatively small. For data collection a standardised survey form is used and entered into a specially developed database program, written in Epi-Info version 6.04d. Inbuilt consistency checks and double entry validation are used to minimise errors in the data file. After the database is cleaned, reports on sample prevalence, causes of blindness and visual impairment, age and sex adjusted prevalence, barriers to cataract surgery, cataract surgical coverage, visual outcome after cataract surgery and details of cataract surgical services can be generated

Table 1 Estimates of prevalence of blindness in 2002 in people age 50+ by WHO subregion

WHO subregion	Country	Prevalence of blindness in people aged 50+ (%)
Amr-A	Canada, Cuba, USA	0.4
Amr-B	Argentina, Bahamas, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Suriname, Uruguay, Venezuela	1.3
Amr-D	Bolivia, Equador, Guatemala, Haiti, Nicaragua, Peru	2.6

automatically through a menu system. All calculations for these reports are coded in the software. Epi-Info modules are used to calculate the sample size and to calculate the inter-observer variation between the different examiners. The manual and software for RACSS are distributed by WHO. RACSS surveys have been carried out in Asia, Africa, Latin America and the former Soviet republics.[13 14]

In 2005 there was a demand to expand the focus from cataract and to include other causes of avoidable blindness as well. To distinguish this new methodology, it was called RAAB: Rapid Assessment of Avoidable Blindness. The cluster sampling methodology was maintained, but for the sampling of households within each cluster the ''random walk'' was replaced by the ''compact segment'' methodology to reduce the chances of bias.[15]

In the random walk method, the survey team starts at the centre of the selected population unit. The direction in which households are visited is determined by spinning a bottle on a hard surface and following the direction of the neck of the bottle. At every crossing a new direction is selected.

In the compact segment method, the population unit is subdivided in segments, each with just enough population to provide the required number of people aged 50+ for the cluster. Then one segment is chosen at random and all households in that segment are visited.

When the population units are small, there will not be much difference between compact segment sampling and the random walk. In larger population units people around the centre have a greater chance of being selected in the random walk method and the chances for selection bias are greater.

The software platform was changed from Epi-Info (DOS) to Visual FoxPro version 8.0 (Windows), the modules to calculate the sample size and to select clusters from the sampling frame were improved, data entry and automatic calculation of the inter-observer variation were added, as well as the option to change the language of the software from English to Spanish, Dutch, French or Chinese. The reports were revised and expanded and the 95% confidence interval for cluster sampling was added. Since 2005 RAAB surveys have been carried out in Kenya, Mexico, Bangladesh, Chile, Philippines, Rwanda, Botswana and China.[16–19]

Both in RACSS and RAAB the eligible people are examined and interviewed in their homes by qualified ophthalmologists or senior ophthalmic residents, ensuring a high compliance rate. That makes the survey simple and fast, but also limits the range of diagnostic equipment. The visual acuity is measured with available distance correction and a tumbling E chart of size 18 at 6 metres and size 60 at 6 metres, 3 metres or 1 metre. Visual acuity with a pinhole is used as a surrogate for best corrected vision. This is much easier and faster to apply than best correction with refraction but it may underestimate visual impairment due to cataract. In the reports, the prevalence of blindness is shown both as pinhole visual acuity of less than 3/60 in the better eye (resembles the WHO definition) and as presenting visual acuity of less than 3/60 in the better eye. Most indicators are calculated for males and for females. The reports show presenting visual acuity because that makes it possible to include visual loss due to refractive errors, a common cause of blindness and visual impairment.

Every eligible person was examined with a torch and a direct ophthalmoscope to assess the lens status. Those with a presenting VA of <6/18 in one or both eyes were further examined to assess the cause of the visual impairment. The eye examination was conducted inside the house in semi-dark condition with a direct ophthalmoscope. Examination with a portable slit lamp and mydriasis is now recommended, but this was not used in any of the studies in Latin America. Without mydriasis the diagnosis of the type of posterior segment disease is less reliable.

RACSS and RAAB are designed as a planning tool, to provide baseline data for initial planning and for monitoring of ongoing blindness intervention programmes. Because of the limited facilities to diagnose posterior segment disease and the small sample size, the findings on posterior segment disease should be regarded as indicative. These results may help to direct more detailed research in future. All RACSS and RAAB studies use the same age group, the same definitions for visual loss and the same method to calculate the indicators. That allows for direct

Table 2 Rapid Assessment of Cataract Surgical Services and Rapid Assessment of Avoidable Blindness studies in Latin America

Country	Survey area	Conditions in survey area	Year	Sample size	Coverage (%)	Population survey area	% 50+
Paraguay	Country	All groups	1999	2136	89.0	4 153 000	12.2
Peru	Piura + Tumbes District	Rural; poor	2002	4782	99.6	1 838 135	13.1
Argentina	Part of Buenos Aires	Urban; poor to middle income	2003	4302	93.5	2 716 573	21.1
Brazil	Campinas city	Urban; all income goups	2003	2224	92.7	980 000	17.8
Cuba	Havana city	Urban, poor/middle income	2004	2760	98.4	2 175 913	32.0
Venezuela	Country	All groups	2004	3317	97.6	23 054 210	13.7
Guatemala	4 provinces	Urban and rural, poor/middle income	2004	4806	98.1	1 339 508	11.9
Mexico	Nuevo Léon State	Urban and rural, poor/middle income	2005	3780	99.6	3 834 141	14.0
Chile	Bio Bio Province	Urban and rural, poor/middle income	2006	3000	97.2	1 861 562	20.4

Table 3 Adjusted prevalence of bilateral blindness (presenting and pinhole vision in better eye) by sex in people aged 50 years and older

	Presenting VA <3/60-NLP			Pinhole VA <3/60-NLP
	Males	Females	Total	Total
Country (survey area)	Prevalence (%)	Prevalence (%)	Prevalence (95% CI)	Prevalence (95% CI)
Paraguay (whole country)	2.8	3.5	3.1 (2.2% to 4.4%)	2.6 (1.6% to 3.6%)
Peru (Piura-Tumbes District)	3.6	4.3	4.0 (3.2% to 4.8%)	2.6 (2.2% to 3.1%)
Argentina (port of Buenos Aires)	1.0	1.5	1.3 (0.9% to 1.6%)	1.0 (0.7% to 1.3%)
Brazil (Campinas city)	1.6	1.6	1.6 (0.9% to 2.2%)	1.4 (0.7% to 2.1%)
Cuba (Havana city)	1.7	2.0	1.9 (1.3% to 2.5%)	1.8 (1.2% to 2.4%)
Venezuela (whole country)	2.1	2.4	2.3 (1.7% to 2.8%)	2.0 (1.5% to 2.5%)
Guatemala (4 provinces)	3.1	4.0	3.6 (2.9% to 4.3%)	3.5 (2.9% to 4.2%)
Mexico (Nuevo Léon State)	2.0	1.1	1.5 (1.1% to 1.9%)	1.3 (0.9% to 1.7%)
Chile (Bio Bio Province)	1.4	1.3	1.4 (0.8% to 1.9%)	1.2 (0.7% to 1.7%)

95% CI, 95% confidence interval.

comparison of the various indicators between different studies in Latin America.

MATERIALS

All nine RACSS and RAAB surveys in Latin America were conducted between 1999 and 2006. The selection of the survey areas was determined by the local non-governmental organisation or university initiating the survey, usually because they had a particular interest in that area. There is considerable variation between the socioeconomic conditions and the availability and affordability of eye care services in the different study areas (table 2).

The proportion of people aged 50 years and older ranged from 11.9% in Guatemala to 32% in Havana. In the mainly urban areas of Buenos Aires, Campinas, Nuevo Léon and Bio Bio, the proportion of people of 50 years and older lies around 20%.

The sample size was calculated on the basis of the expected prevalence of blindness, allowing for a variation of 20% at 95% probability. All data were analysed using the inbuilt report generating modules of the RACSS and the RAAB software.

RESULTS

Table 3 shows the prevalence of bilateral blindness (VA <3/60–NLP) in people aged 50 years or older, with presenting vision and pinhole correction, after adjusting the age and sex composition of the sample population to that of the actual population in the survey area. The calculation of the 95% confidence interval uses the sampling error for cluster sampling according to Bennett *et al*.[20]

WHO defines low vision as VA <6/18 and ⩾3/60 in the better eye with best correction. Table 4 shows the prevalence of people with VA <6/18 and ⩾3/60 in the better eye with available correction. That means that low vision caused by refractive errors is also included. The prevalence of low vision is highest in Peru, Guatemala, Havana, Paraguay and Venezuela.

Table 5 shows the causes of bilateral blindness in these nine surveys. In Paraguay, the cause of blindness other than cataract was not assessed.

Except for Campinas (41%), cataract was the main cause of bilateral blindness with 47% to 87%, followed by posterior segment disease, including glaucoma, diabetic retinopathy and age-related macula degeneration, with 7% to 44%. Cataract was more common among the rural poor and posterior segment among the urban population. Of all blindness 43% to 88% was curable and 52% to 94% avoidable.

Cataract was also the main cause of bilateral low vision (presenting VA <6/18-3/60), except for Buenos Aires and for Nuevo Léon, with 40% to 76%, followed by refractive errors with 18% to 50%. Posterior segment disease caused 2% to 23% of all bilateral low vision. Of all low vision 72% to 97% was curable, 1% to 4% was preventable and 77% to 98% avoidable.

Visual acuity was measured in all aphakic and pseudophakic eyes in the sample (table 6).

This gives an impression of the visual outcome after cataract surgery. These operated eyes may show great variation in postoperative period, in type of surgery, in skills of the surgeon

Table 4 Adjusted prevalence of bilateral low vision (presenting VA <6/18–3/60 in better eye) in people aged 50 years and older by sex

	Presenting VA <6/18–3/60		
	Males	Females	Total
Country (survey area)	Prevalence (%)	Prevalence (%)	Prevalence (95% CI)
Paraguay (whole country)	9.2	12.2	10.7 (9.5% to 12.0%)
Peru (Piura-Tumbes District)	17.8	19.6	18.7 (17.7% to 19.7%)
Argentina (part of Buenos Aires)	5.5	6.2	5.9 (5.1% to 6.8%)
Brazil (Campinas city)	5.8	6.6	6.3 (5.1% to 7.5%)
Cuba (Havana city)	10.6	12.4	11.6 (10.2% to 13.1%)
Venezuela (whole country)	8.7	11.8	10.3 (8.9% to 11.7%)
Guatemala (4 provinces)	11.7	13.3	12.5 (11.2% to 13.8%)
Mexico (Nuevo Léon State)	9.9	7.8	8.8 (7.7% to 9.9%)
Chile (Bio Bio Province)	6.8	8.7	7.8 (6.8% to 8.8%)

95% CI, 95% confidence interval.

Table 5 Causes of bilateral blindness (presenting VA <3/60 in better eye) in eight surveys (%)

Cause of blindness	Peru (n = 193)	Argentina (n = 49)	Brazil (n = 44)	Cuba (n = 65)	Venezuela (n = 74)	Guatemala (n = 198)	Mexico (n = 57)	Chile (n = 47)
Refractive error	1	6	2	0	4	2	0	2
Cataract, untreated	87	47	41	51	68	81	67	57
Aphakia, uncorrected	0	0	0	1	0	2	0	0
Total curable	88	53	43	52	72	85	67	59
Surgical complications	0	0	7	0	0	1	3	0
Trachoma	0	0	0	0	0	0	0	0
Phthisis	0	2	0	0	1	2	0	2
Other corneal scar	1	0	2	5	3	6	0	4
Total preventable	1	2	9	5	4	9	3	6
Total avoidable	89	55	52	57	76	94	70	65
Total posterior segment	12	44	47	43	25	7	30	34

and in surgical conditions. On the other hand, these are the results that patients and their relatives see and it may determine the confidence they have in the surgeon and in the outcome of the operation.

In five of the nine survey areas 90% or more of all cataract operations were with intraocular lens (IOL) implantation. Even in the rural areas in Peru and Guatemala, 82% of all cataract surgeries were with IOL. In Paraguay and in Havana the proportion of IOL implantation was less: 60% and 64% respectively.[21]

The proportion of eyes with a postoperative presenting VA <6/60 was lowest in Buenos Aires (8%) and highest in Guatemala (31%). Results of cataract operations without IOL implantation were worse than those with IOLs: in six of the nine areas more than 50% could not see 6/60 after cataract surgery without IOL. However, in Havana and in Piura-Tumbes, 50 or more of those operated without IOL could see 6/18 or better. Poor outcome after cataract surgery can be due to several causes. Most of these patients were operated long ago and other eye disorders, unrelated to the cataract, may have caused visual impairment after the operation. The non-IOL category also includes operations planned as IOL surgery, where complications occurred and no IOL was implanted.

With pinhole correction, good outcome (VA ⩾6/18) increased 5–16% while moderate outcome (VA <6/18–6/60) reduced by 1–13% and poor outcome (VA <6/60) reduced by 1–9%.

DISCUSSION

All nine surveys described above were conducted using a standardised survey protocol and standardised analysis of cleaned field data. This makes the comparison of the results and extrapolations to other countries easy and reliable. However, great differences exist in the socioeconomic conditions, ethnic background and in awareness, availability and affordability of eye care services between the different countries in Latin America and even within each country—so caution should be applied in making such extrapolations.

The prevalence of blindness in Havana, Cuba, is more than four times higher than the WHO estimate and the prevalence in Venezuela is 50% higher (see table 1). In Brazil, Mexico and Argentina, the surveys were conducted in relatively wealthy urban areas and the prevalence was expected to be lower than the regional estimates. In Peru and Guatemala the surveys were conducted in poor rural areas and the prevalence of blindness was expected to be higher than the regional estimate.

The high prevalence in Havana, despite the excellent healthcare services, may be explained by the proportion of people aged 50 years and older (32%) in Havana, which is as high as in the United States (31%) and in Canada (33%).[22] Because blindness increases with age the incidence of blindness is likely to be equally high. The cataract surgical rate (CSR: the number of cataract operations per million population in a certain year) in Cuba in 2003 was around 2200, the highest in Latin America, but only a third of the CSR of the United States (6500) and of Canada (6000) (WHO, personal communication)

The reported prevalence of severe visual impairment and blindness in Campinas, Brazil, is similar to that found in a 1986 study in Campinas in the same age group: 2.8% with best corrected visual acuity ⩽6/60.[23] The same report mentions for Chile a prevalence of blindness (BCVA ⩽6/60) of 2.9% in people aged 40 years and older, while our study from 2006 indicated a prevalence of 2.3% (pinhole VA <6/60) in people aged 50 years and older.

Table 6 Visual outcome after cataract surgery with presenting VA and with pinhole correction (%)

		Presenting VA			Pinhole VA			
Country (survey area)	No	⩾6/18 (%)	<6/18–6/60 (%)	<6/60 (%)	⩾6/18 (%)	<6/18–6/60 (%)	<6/60 (%)	Use of IOLs (%)
Paraguay (whole country)	93	54	13	33	64	12	24	60
Peru (Piura-Tumbes District)	90	42	32	26	58	21	21	82
Argentina (part of Buenos Aires)	176	69	12	19	74	9	17	94
Brazil (Campinas city)	353	60	18	22	70	13	17	93
Cuba (Havana city)	236	66	12	22	72	9	19	64
Venezuela (whole country)	243	76	14	10	88	3	9	93
Guatemala (4 provinces)	185	40	24	36	56	11	33	82
Mexico (Nuevo Léon State)	242	61	13	26	72	7	21	95
Chile (Bio Bio Province)	140	57	24	19	65	19	16	96

IOLs, intraocular lenses.

Because of the limited data in the global database the results of the surveys presented here may well lead to an adjustment of the blindness estimates for Latin America.

The results of these studies may represent the various situations on eye care services in Latin America. Results from Peru and Guatemala may represent the situation in the rural parts of Latin America with limited eye care services. The results from Paraguay, Venezuela, Mexico and Chile could represent areas with a combined rural and urban population with average availability of eye care services; and the results from Brazil, Argentina and Cuba could represent an urban situation with available eye care services.

The proportion of avoidable blindness is highest in the poor rural areas of Guatemala and Peru (89–94%) and lower in the urban areas of Cuba, Brazil and Argentina (52–57%). Cataract is the most common cause, although less in the urban areas of Cuba, Argentina and Brazil, where posterior segment disease is also a major cause of blindness that require special attention.

Refractive error was not an important cause of blindness with 0% to 6%, but is the second cause of low vision with 18% to 50% after cataract. The high proportion of avoidable blindness and low vision illustrate the urgent need to expand cataract surgery and correction of refractive errors to the poor and underserved population in most countries of Latin America.

The visual outcome of cataract surgery in most of the survey areas is a cause of concern. Especially in Guatemala, Paraguay, Mexico and Peru, improving the quality of cataract surgery should be a priority for the ophthalmologists and the institutions. Providing adequate optical correction after cataract surgery considerably improves visual outcome.

More studies will be required in other countries in Latin America to do justice to the wide variation of conditions. A number of countries have already started implementing Vison 2020 action plans and it would be interesting to repeat the RAAB in these countries to measure the impact of the interventions.

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