WORLD VIEW

Current estimates of blindness in India

G Venkata S Murthy, S K Gupta, D Bachani, R Jose, N John

Series editors: W V Good and S Ruit

See end of article for authors' affiliations

Correspondence to: Dr Gudlavalletti Venkata Satyanarayana Murthy, Community Ophthalmology, Room 787, 7th floor, Dr RP Centre for Ophthalmic Sciences, AIIMS, Ansari Nagar, New Delhi, India - 110029; comoph@vsnl.com

Accepted for publication 11 October 2004

Br J Ophthalmol 2005;**89**:257–260. doi: 10.1136/bjo.2004.056937

Background: Evidence based planning has been the hallmark of the blindness control programme in India. A nationwide survey was undertaken in 1999–2001 to document the magnitude and causes of blindness.
Methods: One district each in 15 populous states was covered. 25 clusters were randomly selected in each district and all individuals aged 50 years and above were enumerated. Presenting and best corrected vision was recorded using retroilluminated logMAR tumbling E charts and detailed eye examination was offered.
Results: The response rate was 89.3%. Presenting vision <6/60, in the better eye, was observed in 8.5% (95% CI: 8.1 to 8.9). Age, sex, residence, literacy, and working status were associated with blindness. The highest risk was among those aged 70+ and the illiterate. Cataract was responsible for 62.4% of bilateral blindness. Prevalence of cataract blindness was 5.3% (95% CI: 4.97 to 5.62). Reduction in blindness prevalence among people aged 50 years and above was observed compared to earlier studies.
Conclusion: Blindness control efforts seem to have played a part in arresting the increasing prevalence of blindness in India and there is hope that the goals of the ''Vision 2020—right to sight'' initiative can be achieved if there is strong political will and prioritised action.

Blindness has been recognised as an important public health problem in India,[1–8] a country that is now home to a billion inhabitants.[9] India was the first country in the world to launch a 100% public funded programme for the control of blindness.[10] This programme has the distinction of emphasising evidence based practice for planning and policy formulation from its very inception.[10 11] The inception, implementation, and identification of appropriate strategies have always been guided by meticulously collected data. Recently, a nationwide survey was undertaken (1999–2001) to document the current situation, trends over the past three decades, and to evaluate the impact of the World Bank supported Cataract Blindness Control Project in the country.[12] Results from the survey indicate that the country may now see a recession in blindness prevalence in the future.

MATERIAL AND METHODS

The National Programme for Control of Blindness, a programme financially supported by public funds from the Government of India undertook a nationwide survey to assess the impact of the augmented national efforts for control of blindness over the period 1999–2001. India is divided into 35 administrative units called states and union territories on a linguistic basis. Fifteen large states were identified for the survey, which accounted for 88% of the country's population. The states also included seven states where a World Bank assisted cataract blindness control project was operational from 1994.[12] Only the population aged 50+ years was included, as past evidence had indicated that 90% of blindness was in this age group.[10] One district (the smallest administrative unit with a population of 1–2 million) was randomly selected from each state.

The demographic data of the 1991 census were used as the sampling frame.[13] The entire district (including the urban areas) was included in the sampling frame. The population size of each village/urban ward in the district was recorded. A listing of all villages/urban wards with their population, based on the census estimates (1991) was first undertaken. Sampling clusters were then created so as to yield a total population of 850–1700 people per cluster. Such clusters were expected to provide 125–250 people aged 50 years and above. The sampling clusters were created by clubbing villages/municipal wards with less than 850 people as one cluster, and by subdividing villages/municipal wards with more than 1700 people into segments, which would yield at least 850 people. In clubbing villages together, geographical proximity of the villages was given prime importance.

Cluster sampling methodology was used. A design effect of 2 was used to adjust for clustering, with an anticipated response rate of 85% for each district. An estimated prevalence of 8% for cataract blindness in each district, a precision of 15%, and 95% confidence levels were used to calculate the sample size of 5000 individuals aged 50+ in each district.

Since the proportion of the Indian population aged 50 years and above was 13.03% (1991 census),[13] the total population of all ages that required to be covered was 38 000 in each district. The number of clusters required to achieve precision was 25 in each district. These 25 clusters were randomly selected from the sampling frame in each district.

After finalisation of the survey design and quality assurance mechanisms, the Government of India invited bids from reputed healthcare institutions to conduct the survey. Twelve institutions with good credentials and experience were identified. They were then contracted to carry out the survey in the selected districts as per the protocol. The survey teams involved were Christian Medical College, Ludhiana, Indian Institute of Health Management Research, Jaipur, Jawaharlal Institute of Post Graduate Medical Education and Research, Pondicherry, Lions Aravind Institute of Community Ophthalmology, Madurai, Mahatma Gandhi Institute of Medical Sciences, Sevagram, NAB-LIONS Hospital, Miraj, Post Graduate Institute of Medical Education and Research, Chandigarh, Rajendra Prasad Centre for Ophthalmic Sciences, New Delhi, Regional Institute of Ophthalmology, Ahmedabad, Sarojini Devi Eye Hospital, Hyderabad, State Institute of Ophthalmology, Allahabad, and Vivekananda Mission Hospital, Chaitanyapur, Haldia. Rigorous training of all the survey teams was conducted at two locations in the country. After the training, each of the survey teams undertook an independent pilot survey before embarking on the main survey.

Table 1 Prevalence of blindness/low vision

Visual acuity cut off	Prevalence of blindness and low vision (95% CI)
<6/60 in better eye	Presenting vision: 8.5% (8.1 to 8.9); range 4.2%–13.7% Best corrected: 4.34% (4.07 to 4.61); range 2.0%–8.5%
<3/60 in better eye	Presenting vision: 5.34% (5.06 to 5.62); range 2.1%–8.9% Best corrected: 3.37% (3.16 to 3.58); range1.6%–5.6%
<6/18–6/60 better eye	Presenting vision: 23.85% (22.97 to 24.72); range 12.2%–37.8%; Best corrected: 9.27% (8.68 to 9.86); range 4.5%–22.2%

A door to door enumeration of all residents aged 50+ in the cluster was first undertaken and all eligible people (50+ individuals residing in the cluster for a minimum of 6 months before the survey) were examined at a specially set up clinical station with a dark room facility in the cluster. Vision was tested using retroilluminated logMAR tumbling E charts. Presenting vision was recorded for all individuals (with the individual's usual correction). In addition, best corrected vision was recorded for all those with vision <6/18 and all those who had undergone cataract surgery in one or both eyes. A detailed eye examination was offered to all the individuals. Basic eye examination consisted of slit lamp and direct ophthalmoscopic examination of the eyelid, globe, pupillary reflex, lens, and fundus. The pupil was dilated only in eyes in which the cause of visual impairment was otherwise not evident. Perimetry was not done. A cause of blindness was recorded for each eye separately in individuals with presenting vision <6/18 in either eye.

Quality assurance was ensured by monitoring of data collection by a technical advisory team, which visited all the survey sites.

Data were recorded on specially designed household and clinical formats. These were then sent to a central processing unit in New Delhi where all the data entry and verification were done. Data cleaning and analysis were done using Stata 8.0.[14] All estimates including confidence intervals were computed using Stata 8.0 for survey data, wherein the primary sampling units were the randomly identified clusters in each district.

Verbal informed consent was obtained from all participants by the use of a scripted consent form.

RESULTS

A total of 72 044 individuals aged 50+ were enumerated. The overall response rate was 89.3%. The response rate was 87.4% among men, and 91.1% in women. The response was consistently above 80% in all districts. More than half (52.7%) were women. 46.9% were aged 50–59 years, 33.8% were aged 60–69 years, and 19.3% were aged 70 years and above. In all, 71% were illiterate and 84.6% were residing in rural areas. Only 18.3% of respondents stated that they were not able to do any work while all others were actively pursuing some work, both outdoor as well as household related.

The prevalence of blindness (presenting vision <6/60 in better eye) was 8.5% (95% CI: 8.1 to 8.9). The prevalence varied from a low of 4.2% to a high of 13.7% across the different districts. The blindness load could be nearly halved by correction (table 1). Presenting vision <6/60 has been traditionally used to define blindness in the Indian context and therefore comparison with earlier studies is possible if the same cut-off point is used. The World Health Organization (WHO) uses presenting vision <3/60 in the better eye for international comparisons. Using this cut off, the prevalence was 5.34% (95% CI: 5.06 to 5.62). The prevalence of low vision (presenting vision <6/18–6/60 in better eye) was 23.85% (95% CI: 22.97 to 24.72) (table 1). The prevalence of blindness was associated with age, sex, literacy, place of residence and working status (table 2). Those aged 70 years and above had a five times higher risk of being blind compared to those aged 50–59 years. Similarly, illiterates had a four times higher risk than those educated to beyond grade 10, while respondents not engaged in any work had two times higher risk compared to those actively working. Females and rural residents also had a marginally higher risk. All differences were statistically significant.

Cataract in one or both eyes was responsible for 62.4% of bilateral blindness. The proportion of blindness due to cataract increased to 72.8% after best correction (table 3). A fifth of all bilaterally blind individuals had uncorrected or poorly corrected refractive errors. Glaucoma and posterior segment causes were other important reasons for bilateral blindness.

Table 2 Sociodemographic correlates of blindness

Demographic characteristics (n)	Prevalence of blindness (presenting vision <6/60) (95% CI)	Adjusted OR (95% CI)	Test of significance	Trend of odds for category
Age groups				
50–59 (29 851)	3.37% (3.09 to 3.65)	1.0		
60–69 (21 445)	9.02% (8.4 to 9.64)	2.4 (2.2 to 2.6)	χ^2, 453.48	
70+ (12 041)	20.31 (19.25 to 21.37)	5.0 (4.6 to 5.5)	χ^2, 1409.41	χ^2, 1541.8; p<0.00001
Sex				
Male (29 980)	6.98% (6.56 to 7.40)	1.0		
Female (33 357)	9.87% (9.34 to 10.40)	1.2 (1.2 to 1.3)	χ^2, 36.46	χ^2, 36.46; p<0.00001
Literacy				
Educated beyond grade 10 (1982)	1.87% (1.30 to 2.44)	1.0		
Educated to grade 6 –10 (5304)	2.24% (1.83 to 2.65)	1.1 (0.7 to 1.6)	χ^2, 0.11	
Educated to grade 5 (11 036)	4.82% (3.69 to 5.33)	1.9 (1.4 to 2.7)	χ^2, 14.1	
Illiterate (44 837)	10.44% (9.96 to 10.92)	3.7 (2.7 to 5.2)	χ^2, 69.39	χ^2, 360.95; p<0.00001
Place of residence				
Urban (9691)	6.48% (5.66 to 7.3)	1.0		
Rural (53 646)	8.87% (8.4 to 9.33)	1.2 (1.1 to 1.4)	χ^2, 20.38	χ^2, 20.38; p<0.00001
Working status				
Actively working (27 107)	5.20% (4.81 to 5.59)	1.0		
Engaged in household work (24 626)	7.04% (6.55 to 7.53)	1.1 (1.0 to 1.2)	χ^2, 4.09	
Not doing any work (11 485)	19.25% (18.1 to 20.4)	2.0 (1.8 to 2.2)	χ^2, 257	χ^2, 320.33; p<0.00001

Table 3 Causes of blindness (in people) (presenting vision <6/60 in better eye)

Causes of blindness	Presenting vision (5385)	Best corrected vision (2746)
Cataract	62.4%	72.76%
Refractive errors	19.65%	1.46%
Glaucoma	5.83%	9.58%
Posterior segment causes	4.72%	5.57%
Corneal opacity	0.89%	1.35%
Posterior capsular opacification	0.89%	1.24%
Surgical complications	1.15%	1.46%
Others including phthisis/absent globe/amblyopia, etc	4.47%	6.59%

The prevalence of cataract blindness was 5.3% (95% CI: 4.97 to 5.62), which was significantly lower than the 8% prevalence assumed for calculating the sample size (table 4). Adjusted odds ratio showed that older age individuals, females, rural residents, illiterates and those not engaged in any work had significantly higher prevalence and risks of cataract blindness (table 4). It was also interesting to observe that the causes of bilateral blindness were also associated with these factors. In those aged 50–59 years, only 55% of bilateral blindness was attributable to cataract while among females, 64.3% could be attributed to cataract.

DISCUSSION

National level surveys in a large country like India are major exercises and cannot be conducted regularly. However, the most important benefit of such surveys is that they generate estimates, which are valid for the whole country.[15] Vision related social and physical function is best reflected by the day to day vision of an individual and this is best assessed by one's presenting vision.[2] Blinding conditions where immediate action can result in improved work potential, patient satisfaction, and visual functioning should be the first priority for community based blindness control programmes. Once a person goes blind from causes like glaucoma, it cannot be reversed and therefore public health action demands identification of individuals before considerable visual impairment has occurred. However, the sensitiveness and positive predictive value of tests available for screening glaucoma at community level are low.[16] In such a context, causes where sight can be restored should be the immediate priorities for elimination of avoidable blindness.

In the absence of national level data, blindness data had been extrapolated to the entire country based on small populations, which may not be representative of the country.[3] The present survey showed that earlier studies where one random district chosen from one state like Andhra Pradesh and Karnataka from which data were extrapolated to the entire country can hardly be representative of the entire country.

Cataract has been documented to be the most significant cause of bilateral blindness both in India as well as on a global scale.[2 4–7] In India cataract has been reported to be responsible for 50–80% of the bilaterally blind in the country.[2 4–6 8 10 11] It has been shown that the age adjusted prevalence of cataract in India was three times that of the United States.[17] There are a 100 million eyes with cataract causing a vision of <6/60 and this number is increasing as a result of population growth and increasing life expectancy, and globally at least 25 million eyes are presumed to become blind because of cataract every year.[18] In such a scenario, global efforts for elimination of avoidable blindness have pledged support for strategies to reduce the burden of

Table 4 Relation between cataract blindness and sociodemographic variables

Sociodemographic variables	Cataract blindness (95% CI)	Proportion of all blind attributed to cataract	Adjusted OR (95% CI)	Test of significance	Trend of odds for category
50+ Population	5.30% (4.97 to 5.62)	62.4%			
Age category					
50–59 years (29 851)	1.85% (1.65 to 2.05)	54.77%	1.0		
60–69 years (21 445)	5.63% (5.15 to 6.11)	62.41%	2.7 (2.4 to 3.0)	χ^2, 360.0	
70+ years (12 041)	13.3% (12.47 to 14.13)	65.52%	5.8 (5.2 to 6.6)	χ^2, 1056.7	χ^2, 1160.3 p<0.00001
Sex					
Male (29 980)	4.14% (3.82 to 4.42)	59.34%	1.0		
Female (33 357)	6.35% (5.93 to 6.77)	64.34%	1.4 (1.3 to 1.5)	χ^2, 52.55	χ^2, 52.55 p<0.00001
Place of residence					
Urban (9691)	4.01% (3.37 to 4.64)	61.94%	1.0		
Rural (53 646)	5.54% (5.17 to 5.91)	62.45%	1.2 (1.1 to 1.4)	χ^2, 12.36	χ^2, 12.36 p=0.0004
Literacy					
Grade 10+ (1982)	1.11% (0.63 to 1.59)	59.46%	1.0		
Grade 6–10 (5304)	1.28% (0.96 to 1.59)	57.14%	0.9 (0.6 to 1.5)	χ^2, 0.09	
Up to grade 5 (11 036)	2.76% (2.39 to 3.13)	57.33%	1.7 (1.1 to 2.6)	χ^2, 5.69	
Illiterate (44 837)	6.59% (6.21 to 6.97)	63.09%	3.5 (2.3 to 5.3)	χ^2, 39.21	χ^2, 224.65 p<0.00001
Work status					
Active work (27 107)	3.18% (2.86 to 3.5)	61.06%	1.0		
Household work (24 626)	4.41% (4.02 to 4.80)	62.67%	1.0 (0.9 to 1.2)	χ^2-0.34	
Not working at all (11 485)	12.12% (11.22 to 13.02)	62.96%	1.8 (1.6 to 2.0)	χ^2, 118.74	χ^2, 147.77 p<0.0001

cataract blindness by the ''Vision 2020—the right to sight initiative.''[19] Realising the potential benefit that elimination of cataract blindness would have on the quality of life of the aged in India, the Government of India sought a soft credit of $US86 million from the International Development Agency of the World Bank during the period 1994–2001 for a cataract blindness control project.[12]

The initiation of the World Bank supported Project in seven populous states that accounted for two thirds of the country's blind has had a cascading effect on the cataract blindness and ophthalmic surgical practice in the country. Intensive efforts launched with contributions from the public and private sector may have contributed to a reduction in the prevalence of blindness. However, the present study design cannot objectively evaluate the efficacy of these efforts. A sea change was witnessed in the surgical techniques adopted and the aspirations of the population who demand intraocular lens implant for better visual outcomes. Ophthalmologists and programme planners have been able to effectively increase cataract surgical output from a low of 1.2 million surgeries in 1992 to a high of 3.86 million surgeries per year in 2003.[20] The prevalence of blindness among people aged 50 years and above has reduced from 9.8% in the same 15 states in the 1986–89 survey, to 8.5% in the current national survey.

The present study has shown that India has been able to arrest the increasing prevalence of blindness. This is significant as it shows that the elimination of blindness is a real possibility and that meticulous planning and careful implementation can bear fruit. It also shows that the success of public health interventions is dependent on a healthy partnership between government, non-governmental organisations, and private sectors being forged to deliver results.

The Indian experience can be a turning point in the history of blindness control attempts as it is likely that organised efforts and media support can reverse trends in blindness and make the success of Vision 2020 a reality for most developing countries. Part of the change in prevalence would also have happened because of secular trends, better availability of services, improved socioeconomic status, etc, and together with a focused programme, the cumulative benefit may be much higher.

Authors' affiliations

G V S Murthy, S K Gupta, N John, Community Ophthalmology, RP Centre for Ophthalmic Sciences, All India Institute for Medical Sciences, New Delhi, India

D Bachani, R Jose, Ophthalmology Section, Directorate General Health Services, Ministry Health and Family Welfare, Government of India, New Delhi, India

Competing interests: none declared.

The Government of India obtained ethical clearance for the study from the Indian Council of Medical Research, New Delhi.

REFERENCES

1 **Dandona L**, Dandona R, Naduvilath TJ, *et al*. Is current eye-care-policy focus almost exclusively on cataract adequate to deal with blindness in India? *Lancet* 1998;**351**:312–16.
2 **Thulasiraj RD**, Nirmalan PK, Ramakrishnan R, *et al*. Blindness and vision impairment in a rural south Indian population: the Aravind Comprehensive Eye Survey. *Ophthalmology* 2003;**110**:1491–8.
3 **Dandona L**, Dandona R, John RK. Estimation of blindness in India from 2000 through 2020: implications for blindness control policy. *Nat Med J India* 2001;**14**:327–34.
4 **Thulasiraj RD**, Rahamathulla R, Saraswati A, *et al*. The Sivaganga eye survey: I. Blindness and cataract surgery. *Ophthalmic Epidemiol* 2002;**9**:299–312.
5 **Nirmalan PK**, Thulasiraj RD, Maneksha V, *et al*. A population based eye survey of older adults in Tirunelveli district of south India: blindness, cataract surgery and visual outcomes. *Br J Ophthalmol* 2002;**86**:505–12.
6 **Murthy GVS**, GuptaSanjeev, Ellwein LB, *et al*. A population-based eye survey of older adults in a rural district of Rajasthan. I. Central vision impairment, blindness and cataract surgery. *Ophthalmology* 2001;**108**:679–85.
7 **Thylefors B**, *et al*. Global data on blindness. *Bull World Health Organ* 1995;**73**:115–21.
8 **Limburg H**, Vaidyanathan K, Pampattiwar KN. Cataract blindness on the rise? results of a door-to-door examination in Mohadi. *Indian J Ophthalmol* 1996;**44**:241–4.
9 **Banthia JK**. *Census of India 2001: Series 1—India: provisional population totals*. New Delhi: Registrar General and Census Commissioner, India, Government of India, 2001:1–311.
10 **Mohan M**. *National survey of blindness—India. NPCB-WHO report*. New Delhi: Minsitry of Health and Family Welfare, Government of India, 1989.
11 **Mohan M**. *Collaborative study on blindness (1971–1974). A report*. New Delhi: Indian Council of Medical Research, 1987:1–65.
12 **Jose R**, Bachani D. World bank assisted cataract blindness control project. *Indian J Ophthalmol* 1995;**43**:35–43.
13 **Vijayanunni M**. *Census of India 1991: state profile 1991—India*. New Delhi: Registrar General and Census Commissioner, India, Government of India, 1998:2–288.
14 **StatCorp**. Stata Statistical Software: Release 8.0. College Station, TX: Stata Corporation, 2003.
15 **Limburg H**, RajKumar, Indrayan A, *et al*. Rapid assessment of prevalence of cataract blindness at district level. *Int J Epidemiol* 1997;**26**:1049–54.
16 **Wormald Richard PL**, Rauf A. Glaucoma screening. *J Med Screening* 1995;**2**:109–14.
17 **Brian G**, Taylor H. Cataract blindness—challenges for the 21st century. *Bull World Health Organ* 2001;**79**:249–56.
18 **Foster A**. Cataract—a global perspective: output, outcome and outlay. *Eye* 1999;**13**:65–70.
19 **Foster A**. Cataract and ''Vision 2020: the right to sight'' initiative. *Br J Ophthalmol* 2001;**85**:635–9.
20 **National Programme for Control of Blindness, India**. Performance of cataract surgery between April 2002 and March 2003. *NPCB-India Quarterly Newsletter* 2003;**2**:2.