Prevalence of Blindness and Visual Impairment in Pakistan: The Pakistan National Blindness and Visual Impairment Survey

Mohammad Z. Jadoon,[1] Brendan Dineen,[2] Rupert R. A. Bourne,[2] Shaheen P. Shah,[2] Mohammad A. Khan,[1] Gordon J. Johnson,[2] Clare E. Gilbert,[2] and Mohammad D. Khan,[1] on behalf of the Pakistan National Eye Survey Study Group

Purpose. To determine the prevalence of blindness and visual impairment in adults aged 30 years and older in Pakistan and to assess socio-demographic risk factors.

Methods. Multistage, stratified (rural/urban), cluster random sampling, with probability proportional-to-size procedures, was used to select a nationally representative, cross-sectional sample of adults 30 years of age or older. Each subject was interviewed; had visual acuity measured (logMAR; logarithm of the minimum angle of resolution); and underwent autorefraction, biometry, and fundus–optic disc examination. Those with less than 6/12 acuity in either eye underwent a detailed ophthalmic examination, including corrected distance visual acuity measurement and dilated ophthalmoscopy.

Results. A nationally representative sample of 16,507 adults (95.5% of those enumerated) was examined. The age- and gender-standardized prevalence of blindness was 2.7% (95% confidence interval [CI], 2.4%–2.9%). It has been estimated that there are 1,140,000 (962,000–1,330,000) blind adults in Pakistan (2003 statistics). Blindness prevalence varied throughout the country, being highest in the provinces of Punjab and Baluchistan and lowest in the North West Frontier Province. Rural areas had a higher prevalence of blindness than did urban areas (3.8% vs. 2.5%, $P < 0.001$). Increasing age and being female were significantly associated with presenting visual acuity of <6/60 (odds ratio [OR], 2.5; 95% CI, 2.3–2.7 and 1.3; 95% CI, 1.1–1.5, respectively). Educational status was also associated with presenting visual acuity of <6/60. Subjects who had attended primary school were 60% ($P < 0.001$) less likely to have acuity of <6/60 than were subjects who had never been to school.

Conclusions. This comprehensive survey provides reliable estimates of the prevalence of visual impairment and blindness in Pakistan. A significant excess of visual impairment was found among the elderly and the uneducated. After adjustment for age differences, women were found to have a significant excess of severe visual impairment and blindness. Regional variations in the prevalence of blindness were also identified. (*Invest Ophthalmol Vis Sci.* 2006;47:4749–4755) DOI: 10.1167/iovs.06-0374

Pakistan, a developing country situated in the World Health Organization's (WHO) Eastern Mediterranean Region, is bordered by India, China, Iran, and Afghanistan. In 1998 the national population was approximately 132 million, making it the sixth most populous country in the world.[1] The four provinces are Punjab, Sindh, North West Frontier Province (NWFP), and Baluchistan. The geography and climate of Pakistan are diverse, consisting of hot arid areas, fertile regions, and the cold, snow-covered Himalayas.

Few studies on blindness and visual impairment had been conducted in Pakistan before this survey. One study (1987–1990), consisting of numerous subsurveys in different areas of the country, estimated the all-age prevalence of blindness to be 1.8%.[2] After this initial study, a National Committee for the Prevention of Blindness (NCPB) was formed, which produced a Five-Year National Plan for the Prevention of Blindness (1994–1999). The purpose of this second survey was to provide more detailed information on the prevalence and causes of visual impairment and blindness, particularly that due to posterior segment disorders, which become increasingly important as life expectancy increases and cataract blindness declines as a result of improved service delivery. The survey reported in this article used a diagnostically rigorous methodology, as was used in the recent prevalence surveys in Bangladesh[3] and India.[4]

The findings reported in this article include (1) the age- and gender-specific prevalence of blindness and visual impairment in adults aged 30 years or more, and (2) the distribution of blindness and visual impairment by gender, age, province, rural–urban place of residence, level of deprivation, and level of education and occupation. The causes of blindness and visual impairment will be published in a separate article.

Methods

A detailed description of the sampling and ocular examination methods is available in a separate publication, which also outlines training, full eye examination protocols, and the results of a rural pilot study.[5] The lower age limit of 30 years was chosen, as it corresponds to other blindness prevalence surveys performed in the region. A brief sum-

From the [1]Pakistan Institute of Community Ophthalmology, Kyber Institute of Ophthalmic Medical Sciences, Peshawar, Pakistan.; and the [2]International Centre for Eye Health, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, United Kingdom.

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Corresponding author: Shaheen Shah, Clinical Research Unit, International Centre for Eye Health, London School of Hygiene and Tropical Medicine, London WC1E 7HT, UK; shaheen.shah@lshtm.ac.uk.

mary of the key methodological details is provided in the following sections.

Sample Size

Based on an assumed prevalence of blindness of 1.8%, a random sampling error precision of 0.3%, a design effect of 2.0, and a 10% increase for potential nonresponse, the total sample size was calculated as 16,600.

Sampling Strategy

Multistage stratified cluster random sampling, with probability proportional-to-size (PPS) procedures, was adopted to select a cross-sectional, nationally representative sample. Before examination, enumeration, using the random walk method, of all persons normally resident in households was undertaken until the target number of adults was attained. This may have meant that there was more than one eligible individual per household. All eligible subjects were asked to attend a survey station, set up in their community, for examination in the following days. Enumerated individuals who did not attend the examination, were examined in their homes whenever possible. If an enumerated individual did not attend for examination, three visits were made to his or her house before the individual was recorded as a nonresponder. Nonresponders were not replaced.

Ethical and Official Government Approval for the Study

Written ethical approval was provided by the Pakistan Medical Research Council (PMRC) in March 2002. This study adhered to the tenets of the Declaration of Helsinki.

Survey Data Collection Process

The WHO categories of visual impairment were used in the study.[6] Blindness was defined as a presenting visual acuity (i.e., with glasses for distance, if normally worn, or unaided) of less than 3/60 (<20/400, logMAR [logarithm of the minimum angle of resolution] >1.30) in the better eye. Severe visual impairment (SVI), was defined as <6/60 to ≥3/60 and moderate visual impairment (MVI) as <6/18 to ≥6/60. We also used the term "near normal" to describe those subjects with a presenting visual acuity of <6/12 (20/40, logMAR 0.3), but ≥6/18 in the better eye. As visual fields were assessed in only a subset of the sample, constricted visual fields were not included in the definition of blindness. The Snellen notation for visual acuity has been used in this article for ease of comparison with the above definitions.

Clinical Examination

Oral informed consent was obtained from each subject by the senior ophthalmic nurse. Personal and demographic data were recorded before eye examination by a trained interviewer. All subjects underwent distance visual acuity measurement with a reduced logMAR tumbling-E chart, which was used because literacy levels are low in Pakistan. Visual acuities were measured in each eye separately at 4 m and at 1 m, if necessary.[7,8]

Based on presenting visual acuity, subjects were either given a red card (visual acuity worse than 6/12 in either eye) or a green card (better than 6/12 in each eye). All patients then underwent an ophthalmic examination by the ophthalmologist. All subjects also underwent automated refraction (Retinomax K-Plus II; Nikon, Tokyo, Japan) and biometry. Red card holders were then examined in more detail, which included retesting visual acuity, with the autorefraction results placed in a trial lens frame. All people with <6/18 vision were referred to the nearest district hospital (these hospitals were sensitized in advance by letters from the local health department). The survey team also provided treatments (free of cost) to the survey subjects if they had minor ailments (e.g., conjunctivitis).

Statistical Analysis

Two trained data processors performed double data entry and were responsible for maintaining the database throughout the survey. Data were entered into Epi Info (provided in the public domain by Centers for Disease Control, Atlanta, GA, and available at http://www.cdc.gov/epiinfo/) and transferred to a commercial software program (Stata ver. 9.0.; Stata Corp., College Station, TX). Age was categorized into 10-year age groups (30–39 and so on, up to age 69), with persons aged 70 years or older entered into one category. Socioeconomic indicators included education (i.e., literate or illiterate, or according to whether the participant had attended school or had a higher education), household occupation, and a deprivation index score. Individuals' occupations were categorized into three categories: nonmanual, manual, or unemployed/student/retired, and household occupation was determined by the highest-status occupation within the household. For example, if there was only one worker and he was a nonmanual worker, his job set the status for that house. If there were two or more working individuals in the household, the house was classified by the highest-status occupation (i.e., using nonmanual > manual > retired > unemployed/student). A deprivation index score at district level, stratified on urban or rural location, was extracted from a report that analyzed the Population and Housing Census data for 1998. This index uses the same criteria as the United Nations Development Program for deriving their Human Poverty Index (i.e., education, housing quality, and congestion, residential services, and employment), and uses a scale from 0 (low deprivation) to 100 (very high deprivation). Karachi district had the lowest deprivation index score (23.64) and rural Baluchistan had some of the highest levels of deprivation.[9]

Descriptive analyses and cross tabulations with calculation of Pearson χ^2 tests were performed. Further analyses were undertaken to explore risk factors for subjects presenting with visual acuities of <6/60, and <3/60 in their better eye. Generalized estimating equations to adjust for dependency in the data due to clustered sampling were used in the modeling. Variables included in the analyses included age, gender, geographical location, deprivation index, and level of education. Univariate, age- and gender-adjusted, and multivariate analyses (with a manual forward step-wise methodology) were performed. All tests are two sided, and the odds ratios (OR) and 95% confidence intervals (CIs) quoted are derived from logistic regression models.

To account for differential nonresponse, the blindness prevalence estimate was standardized by age and gender, using the most recent population estimates.[10] The prevalence of blindness among all ages was also estimated, using published assumptions concerning the prevalence in individuals aged 0 to 29 years[11] (i.e., 0.1%–0.2% for persons aged 15 to 29, and 0.08% for those aged <15 years) and the age and gender standardized data from this survey (i.e., 2.7%, see the Results section).

Results

Study Population and Response Rates

A total of 17,311 subjects aged 30 years or older were enumerated, 16,507 (95.3%) of whom were examined and included in the study. There was some geographical variation in nonresponse: nonresponse was highest in Baluchistan (8.9%) and lowest in Sindh (2.2%). Overall, response rates were higher for women (97.0%) than for men (92.7%; $P < 0.001$). Reasons quoted for nonresponse included: at work, out of town, or unavailable ($n = 586$, 72.9%); refused examination ($n = 138$, 17.2%); disability ($n = 8$, 1%); and other ($n = 28$, 3.5%). No reason was recorded in the remaining 44 individuals (5.5%). The mean age of the sample was 47.3 years (range, 30–105; Table 1). Women accounted for 53.1% of the study sample, their mean age being significantly lower than that of the men (45.9 years vs. 48.9 years respectively; $P < 0.001$).

TABLE 1. Age and Gender of Subjects Included in the Study

Age Group	Male *n*	Male %	Female *n*	Female %	Total *n*	Total %
30–39 years	2,498	28.5	3,457	44.7	5,955	36.1
40–49 years	1,615	18.4	1,974	25.5	3,589	21.7
50–59 years	1,419	16.2	1,451	18.7	2,870	17.4
60–69 years	1,225	14.0	1,120	14.5	2,345	14.2
70+ years	984	11.2	764	9.9	1,748	10.6
Total	8,776	100.0	7,741	100.0	16,507	100.0

Crude Prevalence of Blindness and Visual Impairment

Of those examined, 4416 subjects (26.7%; 95% CI, 26.%–27.4%) were identified with a visual acuity of <6/12 (<0.3 logMAR) in the better eye on presentation. Of these, 561 persons were blind (<3/60; >1.3 logMAR in the better eye). The crude prevalence of blindness was therefore 3.4% (95% CI, 3.1%–3.7%). The crude prevalence of severe visual impairment and blindness (SVI/BL) (i.e., presenting visual acuity of <6/60 in the better eye) was 4.9% (95% CI, 4.5%–5.2%). There were 2364 subjects (14.3%; 95% CI, 13.8%–14.9%) who presented with <6/18 but ≥3/60 in the better eye (MVI and SVI).

After refraction (all subjects) and retesting of visual acuity with corrective lenses (only in those with <6/12 in either eye), 2770 subjects (16.8%; 95% CI, 16.2%–17.3%) had a corrected visual acuity of <6/12 in the better eye. In 121 (21.6%) of the 561 subjects initially presenting with blindness, vision improved to 3/60 or better with correction. The prevalence of blindness after correction was therefore 2.7% (95% CI, 2.4%–2.9%). The prevalence of SVI/BL after correction was 3.3% (547; 95% CI, 3.0%–3.6%). The prevalence of MVI and SVI with correction was half the prevalence when using presenting visual acuities (6.2%; 95% CI, 5.8%–6.6%; Table 2).

Visual Acuity by Age

Increasing age was significantly associated with more severe levels of impaired vision (Table 3). In those aged 30 to 39 years, 94.4% were not visually impaired at presentation (i.e., ≥6/12 in both eyes), whereas only 23.1% of those 70 or older were not visually impaired. Approximately one in five adults aged 70 years or older presented with a visual acuity of <6/60 in the better eye. Blindness prevalence increased with age from 0.4% in those aged 30 to 39 years to 15.7% in persons 70 years or more, the increase being approximately exponential. The majority of the 561 bilaterally blind subjects (489, 87.2%) were aged 50 or older, and the prevalence of blindness in this age group was 7.0% (95% CI, 6.4%–7.7%).

Visual Acuity and Gender

Crude estimates of the prevalence of blindness were similar between men and women (3.4% vs. 3.5%, respectively; Table 3). However, after stratification by age, the prevalence of blindness was higher in women in every age category except those aged 30 to 39 years. Thus, after adjusting for age differences in the sample, the odds of blindness in a woman blind were 30% higher than those in a man (OR, 1.3; 95% CI, 1.1–1.6, $P = 0.001$).

Visual Acuity and Location

Significant differences in visual acuity categories were present throughout the country (Table 4). Punjab and Baluchistan had the highest prevalence of blindness (both 3.8%), followed by Sindh (3.0%). NWFP had the lowest prevalence (2.6%). Men living in Baluchistan were the subgroup with the highest prevalence of blindness (4.1%).

Significantly higher rates of blindness were found in rural than in urban communities (3.8% vs. 2.5%; $P < 0.001$; Table 4). However, people in rural areas tended to be older than people in urban areas ($P < 0.001$), and there were more men living in rural areas than women ($P < 0.001$). Men in rural areas had a significantly higher prevalence of blindness (4.0% vs. 2.0%) than did men in urban areas. This difference was not as marked in women (3.7% rural vs. 3.0% urban).

Visual Acuity and Socioeconomic Indicators

A remarkable 7475 (85.2%) women were found to be illiterate compared with 4167 (53.8%) men. A significant association was found between age and literacy. Among those aged 30 to 39 years, 60% were illiterate compared with 91% of subjects aged 70 years and older. Subjects living in rural areas were more likely to be illiterate than were urban dwellers (76.7% vs. 58.0%). Of the 11,642 illiterate subjects, 11,583 (99.5%) had never attended school. The prevalence of blindness was significantly higher in illiterate subjects than in those who were literate (4.5%; 95% CI, 4.1%–4.9% vs. 0.7%; 95% CI, 0.5%–1.0%), and these differences were significant for both genders (men, $P < 0.001$; women, $P = 0.006$). Even after adjusting for age, illiterate subjects had greatly increased odds of blindness (OR, 3.4; 95% CI, 2.4%–4.8, $P < 0.001$) compared with literate subjects. Overall, 0.7% of subjects from nonmanual households were classified as blind compared with 2.9% in manual households and 4.2% in households classified as unemployed/student/retired. Statistically significant differences in deprivation scores were found between subjects who presented blind

TABLE 2. Presenting and Corrected Visual Acuity in the Better Eye

Presenting Visual Acuity	Corrected Visual Acuity*: Normal (≥6/12)	Near Normal (<6/12 to ≥6/18)	MVI† (<6/18 to ≥6/60)	SVI‡ (<6/60 to ≥3/60)	Blind (<3/60)	Total
Normal (≥6/12)	12,091 (100%)					12,091 (100%)
Near normal (<6/12 to ≤6/18)	1,035 (69.4%)	456 (30.6%)				1,491 (100%)
MVI† (<6/18 to ≥6/60)	591 (27.9%)	795 (37.5%)	735 (34.6%)			2,121 (100%)
SVI‡ (<6/60 to ≥3/60)	11 (4.5%)	30 (12.4%)	108 (44.4%)	94 (38.7%)		243 (100%)
Blind (<3/60)	9 (1.6%)	23 (4.1%)	76 (13.6%)	13 (2.3%)	440 (78.4%)	561 (100%)
Total	13,737 (83.2%)	1,304 (7.9%)	919 (5.6%)	107 (0.7%)	440 (2.7%)	16,507 (100%)

* Correction with trial lenses based on results of autorefraction.
† Moderate visual impairment.
‡ Severe visual impairment.

Table 3. Prevalence of Different Levels of Visual Loss, Stratified by Age and Gender

Presenting Visual Acuity, Better Eye	n (%)	Age Group (y)				
		30–39	40–49	50–59	60–69	70+
Near normal (<6/12 to ≥6/18)						
Male	605 (40.6)	1.6	4.1	10.8	16.0	15.4
Female	886 (59.4)	2.7	8.5	17.9	21.0	16.9
MVI (<6/18 to ≥6/60)						
Male	935 (44.1)	1.6	4.8	11.2	23.5	37.7
Female	1186 (55.9)	3.7	9.6	16.5	29.1	39.7
SVI (<6/60 to ≥3/60)						
Male	127 (52.2)	0.2	0.2	0.9	3.3	6.81
Female	116 (47.7)	0.1	0.4	1.4	3.2	6.3
Blind (<3/60)						
Male	259 (46.2)	0.6	1.1	2.2	4.7	14.0
Female	302 (53.8)	0.3	1.5	2.8	7.5	17.9

compared with those presenting with better visual acuities (mean deprivation scores 60.8 vs. 57.4, respectively; $P < 0.001$).

Association Analysis: Subjects Presenting with SVI/BL

A total of 804 subjects presented with a visual acuity of <6/60 in the better eye (i.e., SVI/BL; Table 5). Age was the most significant risk factor, with the odds displaying a linear increase with each decade above 30 years (adjusted OR, 2.5; 95% CI, 2.3–2.7; $P < 0.001$). The women had greater odds of SVI/BL than did the men, after adjustment for age (OR, 1.3; 95% CI, 1.1–1.5; $P = 0.003$). However, due to the strong association between gender and educational status, after adjustment for education, there were no statistical differences in gender.

Significant differences existed in SVI/BL throughout the country. Compared with NWFP, subjects in all other districts had greater odds of being SVI/BL: subjects in Baluchistan had 70% higher odds (95% CI, 10%–170%), Sindh had 60% (95% CI, 10%–140%), and Punjab had 40% (95% CI, 10%–80%). Univariate and age- and gender-adjusted analyses showed rural dwelling to be significantly associated with higher odds of SVI/BL than urban dwelling (OR, 1.3; 95% CI, 1.1%–1.5). However, after accounting for the association of education and rural/urban residence in the multivariate-adjusted model, this association became insignificant.

Educational status was strongly associated with SVI/BL. Subjects who had attended primary school were 60% less likely to be SVI/BL than were subjects who had never been to school. Similarly, subjects who had attained more than primary level education were 70% (50%–80%) less likely to have SVI/BL than were subjects never attending school.

Regression models for subjects presenting with <3/60 in the better eye gave results very similar to those just presented.

Estimation of the Magnitude of Blindness in Pakistan

The crude prevalence of blindness was age and gender standardized by using the most recent official population estimates.[10] The age- and gender-standardized prevalence of blindness among Pakistani adults 30 years of age or older was 2.7% (95% CI, 2.4%–2.9%). The estimated number of blind adults aged 30 years and older in each of the provinces is shown in Table 6.

Based on the statistics presented herein, the prevalence of blindness among individuals of all ages in Pakistan is estimated to be 0.9% (95% CI, 0.8%–1.0%). The estimated number of blind individuals of all ages in Pakistan in 2003 was estimated to be 1.25 million (1.1–1.35 million). Using population projections[12] for the whole population of Pakistan, the number of blind people in Pakistan will increase to approximately 2.4

Table 4. Presenting Visual Acuity in the Better Eye, by Gender, Province, Location, and Literacy

	Normal (%)	Near Normal (%)	MVI (%)	SVI (%)	Blind (%; 95% CI)
Gender					
Men	5,815 (75.1)	605 (7.8)	935 (12.1)	127 (1.6)	259 (3.4;3.0–3.8)
Women	6,276 (71.6)	886 (10.1)	1,186 (13.5)	116 (1.3)	302 (3.5;3.1–3.8)
Province					
NWFP	2,380 (76.9)	256 (8.3)	342 (11.0)	37 (1.2)	79 (2.6;2.0–3.2)
Punjab	6,348 (72.1)	852 (9.7)	1,159 (13.2)	109 (1.2)	336 (3.8;3.4–4.2)
Sindh	2,638 (72.0)	315 (8.6)	519 (14.2)	82 (2.2)	110 (3.0;2.5–3.6)
Baluchistan	725 (76.7)	68 (7.2)	101 (10.7)	15 (1.6)	36 (3.8;2.7–5.2)
Location					
Rural	8,109 (73.2)	981 (8.8)	1,392 (12.6)	177 (1.6)	425 (3.8;3.5–4.2)
Urban	3,982 (73.4)	510 (9.4)	729 (13.4)	66 (1.2)	136 (2.5;2.1–3.0)
Literate					
Yes	4,238 (87.1)	282 (5.8)	290 (6.0)	19 (0.4)	35 (0.7;0.5–1.0)
No	7,852 (67.5)	1,209 (10.4)	1,831 (15.7)	224 (1.9)	526 (4.5;4.1–4.9)

Normal (≥6/12); near normal (<6/12 to ≥6/18); MVI (<6/18 to ≥6/60); SVI (<6/60 to ≥3/60); blind (<3/60).

TABLE 5. Risk Factors for Severe Visual Impairment and Blindness

	n	Univariate Analysis OR (95% CI)	Age-Adjusted OR (95% CI)
Age group (y)			
30–49	35	1	NA
40–49	57	2.7 (1.7, 4.3)	NA
50–59	104	6.4 (4.1, 10.0)	NA
60–69	218	17.3 (11.6, 25.8)	NA
70+	390	48.4 (32.8, 71.5)	NA
Gender			
Male	386	1	1
Female	418	0.9 (0.8, 1.1)	1.3 (1.1, 1.5)
Province		1	
NWFP	116		1
Baluchistan	51	1.5 (0.9, 2.2)	1.7 (1, 2.7)
Punjab	445	1.4 (1.1, 1.7)	1.3 (1.1, 1.7)
Sindh	192	1.4 (1.0, 2.0)	1.5 (1.0, 2.0)
Location			
Urban	202	1	1
Rural	602	1.5 (1.2, 1.8)	1.3 (1.1, 1.5)
Schooling			
None	750	1	1
Primary	24	0.2 (0.1, 0.37)	0.4 (0.2, 0.6)
Higher	30	0.1 (0.1, 0.2)	0.3 (0.2, 0.4)
Total	804		

million by the year 2020, assuming that the prevalence of blindness remains unchanged.

DISCUSSION

WHO's global database on blindness and low vision, which uses data from population-based surveys, has recently been updated.[11] The revised estimates indicate that there are currently 37 million people who are blind worldwide (based on the global population of 2002). This estimate is lower than the 1999 projection of 45 million, which was based on extrapolations of 1995 data.[13] The all-age prevalence estimate from this survey (0.9%; 95% CI, 0.8%–1.0%) agrees with the database, which has estimated the prevalence of blindness in populations in the Eastern Mediterranean subregion (EMR-D, in which Pakistan is included) to be 1.0%.[11] The WHO database highlights the importance of population-based data in setting priorities, and in assessing the impact of eye care service provision on the prevalence and causes of blindness. The survey reported in this article adds additional information and provides disaggregated and risk factor data that can be used for planning at the provincial level and for targeting high-risk groups.

The strengths of this survey are the experience of the study team, the sampling methodology used, the strict adherence to enumeration and clinical protocols, and a higher than expected response rate (95.3%). The higher acuity threshold used in this survey allows the burden of refractive errors to be assessed, which, with cataract, are two of the priority conditions of the WHO global initiative VISION2020—Right to Sight. The results of this survey are quoted using the day-to-day vision of the subject (presenting visual acuity) which best assesses the social and physical functioning of that person in their environment.[14]

TABLE 6. Estimated Number of Blind Adults in Each Province of Pakistan

Province	Estimate	95% CI
Punjab	769,000	682,000–864,000
Sindh	200,000	159,000–250,000
NWFP	114,000	88,000–144,000
Baluchistan	52,000	35,000–77,000
Total	1,140,000	962,000–1,330,000

Data are based on the age/gender-standardized prevalence of blindness.[10]

For logistic reasons, perimetry was conducted in only a selected subgroup of subjects, which means that individuals who would have been classified as blind on the basis of visual field defects alone (e.g., from glaucoma or retinitis pigmentosa) would have been underreported. Another limitation of this survey, as with all cross-sectional studies, is the lack of temporality of risk factor data, which means that significant associations should be interpreted with caution.

Although the overall response rate was high, men in Punjab and women in Baluchistan had the lowest response rates. Men may have been unable to attend due to work commitments, and cultural factors may have led to a lower response rate among women in Baluchistan, where, owing to the low population density, distances to the examination sites were sometimes considerable. It is difficult to assess how this nonresponse may have biased the findings. One can postulate that nonresponding men would be unlikely to be visually impaired if they were away from home on account of work, and this may explain the higher prevalence of blindness among men aged 30 to 39 years, compared with women of the same age.

The crude blindness prevalence in adults was 3.4% (95% CI, 3.1%–3.7%). The prevalence increased almost exponentially with age, culminating in a blindness prevalence of 15.7% in individuals older than 70 years. The odds of SVI/BL (<6/60 vision) increased by 2.5 times for every decade over 30 years. This dramatic increase in age has been found in all other population-based prevalence surveys.

Overall, 4.8% of the women surveyed had a visual acuity of <6/60 compared with 5.0% of the men, but with age stratification, all women older than 40 years had a higher prevalence of blindness. Thus, after adjustment for age differences, women had a 30% higher odds of presenting with visual acuity of <6/60 (95% CI, 1.1%–1.5). Previous studies in districts in NWFP found women to be more likely to be blind[15] or visually impaired[16] than men, and a rapid-assessment study conducted in northern Punjab found nearly double the prevalence of blindness in women than in men.[17] Other studies in South Asia have also found women to have significantly higher rates of blindness than men after adjusting for age and other risk factors.[4,18,19] The Sivaganga Eye Survey, conducted in southern India, found women to be significantly more likely to be visually impaired than men, but in their multivariate analysis, as in ours, gender differences were not found to be significant.[20] This gender difference appears to be a world-wide phenomenon, and globally the age-adjusted odds of blindness in women is 43% higher than in men (95% CI, 1.33–1.53).[21] Lower uptake of eye care services is one explanation, and barriers specific to women must be addressed to increase uptake.

Geographical differences in SVI/BL were apparent, possibly reflecting inequalities in healthcare delivery or variation in environmental or other risk factors. Baluchistan, which is a sparsely populated, hot and dry region, had the lowest proportion of subjects aged 70+ years, yet had the highest prevalence of SVI/BL. Multivariate analysis, adjusting for differences in age, gender, educational achievement and rural or urban dwelling, showed that, compared with NWFP, subjects in all the other provinces had 40 to 70% greater odds of SVI/BL. The previous national study also found the lowest blindness prevalence in NWFP and the highest in Baluchistan.[2] Subjects living in rural clusters had significantly greater odds of SVI/BL than those living in urban clusters, even after adjustment for age and gender. However, this association became insignificant in the multivariate model, probably on account of educational differences between rural and urban areas. Similar rural/urban differences have also been reported from India.[14]

As in similar surveys in South Asia, socioeconomic indicators were strongly associated with visual acuity status.[3,22–23] Illiterate subjects were significantly more likely to have a presenting visual acuity of <6/60. Subjects with primary level schooling were 60% (40%–80%) less likely to present with a visual acuity of <6/60 than were subjects who had never attended school, and subjects who had a higher education were even less likely to have SVI/BL (OR, 0.3; 95% CI, 0.2–0.4). Blindness was less prevalent in households with a nonmanual work status than in those with a manual work status. A significantly higher blindness prevalence was found in districts with a higher deprivation index ($P < 0.001$). The results of this survey indicate that there are vulnerable groups in Pakistan who should be targeted for intervention. These include individuals living in districts with high levels of deprivation (mainly rural districts) as well as those who are elderly, poorly educated, and female.

The age- and gender-standardized prevalence of blindness in adults over the age of 30 years was estimated to be 2.7% (95% CI, 2.4%–2.9%). This estimate is 76% higher than the estimate in a national survey of adults of similar age in Bangladesh, which used a similar methodology.[3] Different age structures between the two countries, exemplified by the fact that in Bangladesh only 6.9% of the study population were older than 70 years compared with 10.6% in the current survey, may, in part, explain this difference. Studies conducted in India found the prevalence of blindness (presenting acuity <3/60 in the better eye) to be 5.3% in subjects older than 50,[14] which was lower than the rate in similarly aged individuals in this survey (7.0%). Another survey in southern India estimated the prevalence of blindness to be 4.3% in subjects older than 40 years,[24] and in Nepal the blindness prevalence in subjects older than 45 years was estimated to be 3.0%.[11] Comparison of the findings of these surveys with the Pakistan data is difficult given the different age groups sampled, but it appears that Pakistan has far more visual disability than other countries in south Asia.

The 1990 study in Pakistan, in which the all-age blindness prevalence was estimated, a less rigorous methodology was used than in the current survey, raising the possibility that the prevalence estimate of 1.8% is biased.[2] The current all-age blindness prevalence estimate is 0.9% (95% CI, 0.8%–1.0%), suggesting a reduction in overall blindness prevalence. The current estimate suggests that there are 1.25 million blind individuals of all ages in Pakistan (using 2003 population data) compared with Memon's[2] estimate of 2 million in 1990. The results of the current survey appear to concur with recent data from the WHO database that have shown a less than predicted increase in the number of individuals who are cataract blind (the principal cause; 15.9 million worldwide in 1990 increasing by only 1.7 million in 2002), despite a 30% increase in the global population 50 years of age and older.[25] Possible reasons for this include improvements in service delivery for cataract. The apparent reduction in blindness prevalence in Pakistan should not be a cause for complacency, however, as the number of individuals who are blind will continue to increase as the population grows and ages. Our projection of a 92% increase in the number of blind individuals between 2003 and 2020 has been calculated with the assumption that the prevalence of blindness in adults will not change. A recent pledge by the Ministry of Health of 2.8 billion rupees (~50 million U.S. dollars) over 5 years to support eye care delivery demonstrates the government of Pakistan's commitment to these growing requirements.

This survey provides information that can be used for planning at national and provisional levels and highlights vulnerable groups that should be targeted.

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APPENDIX

The Pakistan National Eye Survey Study Group

Shad Mohammed, Zia Uddin Sheik, Professor Asad Aslam, Nasim Panazai, Shabbir Mir Niaz Ali, and Pak Sang Lee, Technical Coordinator (International Centre for Eye Health, London); Ikram Ullah Khan (Biomedical Engineer, Pakistan Institute of Community Ophthalmology); Haroon (Sight Savers International); Rubina Gillani (Fred Hollows Foundation); Babar Qureshi (Christoffel Blindenmission); Mohammed Shabbir and Falak Naz (Clinical and Community Ophthalmologists, respectively, North West Frontier Province Team); Abdul Ghafoor and Dr Kiramatullah (Survey Ophthalmologists, Punjab and Baluchistan Teams); and Waheed Shaikh and Amjad Shaikh (Survey Ophthalmologists, Sindh Team).