# Vision loss in Australia

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## ABSTRACT

**Objective:** To assess the prevalence and causes of vision loss in Australia and to project these data into the future.

**Design:** Synthesis of data from two cross-sectional population-based cohort studies — the Melbourne Visual Impairment Project and the Blue Mountains Eye Study — and extrapolation to the entire Australian population.

**Setting and participants:** 8376 community and 533 nursing home residents recruited between 1992 and 1996 in urban and rural Victoria and New South Wales.

**Main outcome measures:** Age-standardised prevalence of low vision (visual acuity < 6/12) and blindness (visual acuity < 6/60) (both measured in the best eye, with spectacles if usually worn for distance vision), and their causes for the Australian population for 2000 to 2024, projected from Australian Bureau of Statistics population data.

**Results:** In 2004, 480 300 Australians were estimated to have low vision, including 50 600 with blindness. The most common causes of low vision were undercorrected refractive error (62%), cataract (14%) and age-related macular degeneration (10%). The latter was responsible for almost half of all cases of blindness. The numbers of people with low vision and blindness are projected to almost double by 2024.

**Conclusions:** Vision loss in Australia is a much bigger problem than is usually recognised; 76% of low vision is caused by uncorrected refractive error or cataract, both readily treatable. However, the prevention and treatment of macular degeneration poses a major challenge.

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Until 10 years ago, there was almost no information on the prevalence or causes of vision loss in Australia. The scant data available usually came from clinic records or blindness registrations.[1,2] Population-based prevalence data are critical for developing management programs and for identifying areas for research.[3]

The few data available suggested changes in the epidemiology of vision loss. The major causes of 100 years ago (corneal infection and ocular trauma) and 50 years ago (cataract and diabetic retinopathy) were clearly being better managed and no longer predominated.[4] The level of vision loss causing economic disability had also clearly changed. Seventy-five years ago, economic disability was defined to occur with vision of less than 6/60 (“legal blindness”), but, in modern times, the importance of driving means that vision less than 6/12 (“driving vision”) imposes significant economic and social restrictions.[5-8]

Between 1992 and 1996, two population-based surveys of eye disease and vision loss were conducted in Australia: the Melbourne Visual Impairment Project and the Blue Mountains Eye Study.[9-11] These two surveys used generally similar methods and obtained overall similar results, although differing in some findings.

We reanalysed the combined dataset of these two studies to provide a comprehensive assessment of the prevalence and causes of vision loss in Australia as a basis for predicting future needs.

## METHODS

### Melbourne Visual Impairment Project

The Melbourne Visual Impairment Project (MVIP) was a population-based study of urban, rural and institutionalised residents of Victoria aged 40 years or older. Detailed methods have been published previously.[5,9,10] Briefly, 4744 participants were recruited from randomly selected pairs of adjacent census collector districts — nine in urban Melbourne and four in rural communities in Victoria. A door-to-door household census was conducted to identify residents who had lived in their homes for at least 6 months and were aged 40 years and older. A further 403 participants were recruited from 12 nursing homes and two hostels randomly selected from 104 nursing homes and hostels located within a 5 km radius of the nine selected urban pairs of census districts. All residents of the selected nursing homes and hostels were eligible to participate in the study. The urban study was carried out from 1992 to 1994, the nursing home and hostel study in 1995, and the rural study in 1996.

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The Human Research and Ethics Committee of the Royal Victorian Eye and Ear Hospital, Melbourne, approved the protocol, and all participants gave written informed consent.

Participants completed a standardised questionnaire covering sociodemographic characteristics, symptoms of eye disease, medical history and medication use. They were also invited to a local examination centre for a standard ophthalmic examination. Home visits were conducted for participants unable to attend the local examination centre. The examination included presenting visual acuity (which is measured with participant’s spectacles, if usually worn for distance viewing), visual field, intraocular pressure, slit-lamp examination, dilated ophthalmoscopy and photography of the lens and the fundus. Best-corrected visual acuity was measured for those with vision less than 6/6, using a standardised refraction.

### Blue Mountains Eye Study

The Blue Mountains Eye Study (BMES) was a population-based survey of non-institutionalised residents aged 49 years and older from two postcode urban areas in the Blue

**1 Population characteristics and results of the surveys of eye disease**

| | Melbourne Visual Impairment Project | | Blue Mountains Eye Study | |
|---|---|---|---|---|
| | Rural–urban | Nursing home–hostel | Rural–urban | Nursing home–hostel |
| No. of participants | 4744 | 403 | 3632 | 130 |
| Participation rate | 85% | 90% | 82% | 96% |
| % women | 53% | 79% | 57% | 65% |
| Median age in years (range) | 58 (40–98) | 84 (47–102) | 66 (50–97) | 78 (51–102) |
| % in age group | | | | |
| < 50 years | 27% | 1% | 0 | 0 |
| 50–59 years | 28% | 1% | 27% | 5% |
| 60–69 years | 25% | 6% | 36% | 15% |
| 70–79 years | 15% | 23% | 26% | 35% |
| 80–89 years | 5% | 46% | 9% | 35% |
| 90 + years | 1% | 23% | 1% | 10% |
| % with low vision | 4% | 38% | 11% | 31% |
| % with blindness | 0.5% | 35% | 0.5% | 9% |

Mountains region, west of Sydney, NSW. Detailed methods have been published previously.[6,10,11] A door-to-door census was conducted of the two postcode areas to identify 4433 eligible residents; 3654 (82.4%) attended a local clinic for a detailed eye examination. A further 135 nursing home residents within the region were also examined.

Participants completed a questionnaire on demographic characteristics, medications, visual function and medical history at the clinic visit. The detailed eye examination included presenting and best-corrected visual acuity, a screening visual field test, applanation tonometry, and stereo-optic disc photography. Best-corrected visual acuity was measured for those with vision less than 6/6, using a standardised refraction. The Western Sydney Area Human Research and Ethics Committee approved the protocol of the BMES, and all participants gave written informed consent.

### Definitions

For our analysis, all participants were classified according to the vision in their better eye. Low vision was defined as presenting visual acuity (measured with spectacles if worn for distance viewing) < 6/12 in the better eye. It was attributed to refractive error if best-corrected visual acuity was ⩾ 6/12, and to another cause if best-corrected vision remained < 6/12.

Blindness was similarly defined as presenting visual acuity < 6/60 in the better eye and was attributed to refractive error if best-corrected visual acuity was ⩾ 6/60, and to another cause if best-corrected vision remained < 6/60.

Cases of vision loss not caused by refractive error were attributed to the major disease in the better eye. This was defined as the most clinically significant and irreversible disease if more than one disease was present.

### Statistical analysis

Data were analysed using SAS software, version 8.2.[12] Participants were divided into 5-year age groups, except those aged 95 years or older who were included in a 95 + age group. For each study, we determined the proportion of women, proportion of participants in each 5-year age group, and proportions with low vision, blindness and particular causes of vision loss. We derived 95% confidence intervals from logistic regression without covariates. Data are presented in 10-year age groups.

To adjust for variations in sampling frequencies, the data for each study were weighted to match the age distribution of the estimated Australian population for 2001[13] before they were combined and analysed. Weighting factors were determined for each 5-year age group at each location (rural–urban or nursing home–hostel) in each study. The numerators for the prevalence of low vision or blindness were the sum of weighted cases for each cause of low vision or blindness.

Age-standardised data were used to estimate the numbers of people with low vision, blindness and the various causes of vision loss, and the prevalence for the entire Australian population for 2004. Numbers and prevalence figures were extrapolated to the years 2000, 2010, 2014, 2020 and 2024 using Australian population figures or projections provided by the Australian Bureau of Statistics. The 95% CIs were calculated from logistic regressions without covariates.

## RESULTS

Data were available for a total of 8909 participants, with participation rates greater than 80% for both the MVIP and BMES studies (Box 1). The MVIP cohort included more younger people than the BMES.

From these data we estimated that in 2004 there were 480 300 Australians with uncorrected or uncorrectable low vision, including 50 600 Australians with uncorrected or uncorrectable blindness (Box 2). Overall, 62% of presenting low vision and 4% of presenting blindness was caused by correctable refractive error, either myopia or hypermetropia. Of 183 600 Australians with low vision not caused by refractive error, the most common causes were cataract (37%) and age-related macular degeneration (26%). The most common cause of blindness (presenting visual acuity less than 6/60) was age-related macular degeneration (48%) (Box 2).

The estimated prevalence of low vision and blindness in 2004 is shown by 10-year age group in Box 3. The estimated prevalence increased exponentially with age; 39% of Australians aged 90 years or more were estimated to have low vision, including 17% with blindness.

Predicted numbers of Australians who will have low vision or blindness over the years 2000 to 2024 are shown in Box 4. The number will almost double, from 430 000 in 2000 to almost 800 000 in 2024.

## DISCUSSION

This study combined the findings of two independent population-based studies of eye disease to estimate the prevalence of vision loss in Australia and to project this figure into the future. The study estimated that nearly half a million Australians have low vision (either uncorrected or uncorrectable) and that this number will nearly double in the next 20 years with the ageing of the population.

The strengths of this study are that it combines two large concurrent population-based studies of eye disease conducted in

**2 Estimated numbers of people with low vision and blindness caused by different conditions in Australia, 2004**

| | Low vision (PVA < 6/12) | | | Blindness (PVA < 6/60) | | |
|---|---|---|---|---|---|---|
| Cause | Estimated number (95% CI) | % (including RE) | % (excluding RE) | Estimated number (95% CI) | % (including RE) | % (excluding RE) |
| Age-related macular degeneration | 48 300 (43 200–73 900) | 10% | 26% | 24 200 (21 400–52 400) | 48% | 50% |
| Glaucoma | 13 700 (12 600–38 800) | 3% | 8% | 6 900 (6 000–30 900) | 14% | 14% |
| Cataract | 68 700 (61 700–94 600) | 14% | 37% | 6 100 (5 400–31 400) | 12% | 13% |
| Diabetic retinopathy | 7 800 (7 200–31 000) | 2% | 4% | 5 700 (5 200–64 800) | 11% | 12% |
| Other retinal | 15 900 (14 700–34 500) | 3% | 9% | | | |
| Neuro-ophthalmic | 8 700 (7 900–27 800) | 2% | 5% | 1 400 (1 300–28 800) | 3% | 3% |
| Other | 20 500 (18 900–26 400) | 4% | 11% | 4 400 (4 000–29 600) | 9% | 9% |
| Refractive error | 296 700 (275 900–320 600) | 62% | – | 1 900 (1 700–30 800) | 4% | – |
| Total | 480 300 (441 400–522 700) | | | 50 600(45 100–74 500) | | |

RE = refractive error. PVA = presenting visual acuity (with spectacles if usually worn for distance viewing).

**3 Estimated age distribution of people with low vision and blindness in Australia, 2004**

| Age group (years) | Low vision (PVA < 6/12) Estimated no. (95% CI) | Low vision Age-specific prevalence (95% CI) | Blindness (PVA < 6/60) Estimated no. (95% CI) | Blindness Age-specific prevalence (95% CI) |
|---|---|---|---|---|
| 40–49 | 19 800 (18 200-21 400) | 0.67 (0.62–0.72) | 0 (0–14 200) | 0 (0–0.48) |
| 50–59 | 57 500 (54 300-60 900) | 2.28 (2.16–2.42) | 2 308 (2 200-5 400) | 0.09 (0.09–0.22) |
| 60–69 | 73 200 (69 200-77 300) | 4.51 (4.27–4.76) | 4 600 (4 400-4 900) | 0.29 (0.27–0.30) |
| 70–79 | 132 200 (123 600-141 300) | 11.41 (10.67–12.20) | 7 900 (7 400-8 500) | 0.68 (0.64–0.73) |
| 80–89 | 172 300 (155 200-190 200) | 28.75 (25.92–31.75) | 24 700 (22 300-27 400) | 4.12 (3.71–4.58) |
| 90 + | 25 400 (20 700-31 700) | 39.49 (31.23–47.76) | 11 000 (8 800-14 000) | 16.94 (13.29–21.13) |

PVA = presenting visual acuity (with spectacles if usually worn for distance viewing).

two distinct Australian populations. Both studies had very high participation rates and used standardised methods and assessments. They covered slightly different age ranges and were geographically separate with some variations in socioeconomic and demographic characteristics.[10,11] A weakness in this analysis is that the two studies used somewhat different methods and disease definitions. However, we consider that the surveys were sufficiently similar for it to be reasonable to combine their data. In some instances, for example, the measurement of visual acuity or the grading of retinal photographs, identical methods and definitions were used.

The combination of the two datasets with appropriate adjustments gives a more robust and precise estimate of vision loss and its causes in Australia than was available from either study on its own or from previous estimates. Australia is unique in the world in having such a substantial dataset on blindness and eye disease, and Australian data have been used widely as a basis for estimating prevalence in other countries, such as the United States.[14]

The Australian data clearly show the exponential increase of vision loss with increasing age, and the impact that the increasing ageing of the population will have on the number of people with vision loss and blindness and in our community.

These data also reveal the unrecognised importance of undercorrected refractive error in causing functional vision impairment. Visual acuity less than 6/12 is associated with a significant reduction in quality and length of life and in the capacity of individuals for healthy and independent ageing.[5-8] Although impairment that is not correctable by refraction usually has greater impact, impairment that is correctable with spectacles or a change in existing spectacles has measurable impacts on the independent

**4 Projected number of people with low vision and blindness in Australia**

| Year | Estimated no. (95% CI) Low vision (PVA < 6/12) | Estimated no. (95% CI) Blindness (PVA < 6/60) |
|---|---|---|
| 2000 | 431 100 (394 700–469 100) | 47 700 (41 800–70 100) |
| 2004 | 480 300 (441 400–522 700) | 50 600 (45 100–74 500) |
| 2010 | 560 500 (514 300–611 300) | 62 000 (55 100–88 400) |
| 2014 | 619 700 (568 500–675 800) | 68 800 (61 100–96 800) |
| 2020 | 716 400 (657 700–780 700) | 78 300 (69 600–107 700) |
| 2024 | 799 100 (733 500–870 800) | 87 600 (78 000–118 100) |

PVA = presenting visual acuity (with spectacles if usually worn for distance viewing).

living of older people.[6] Consequently, undercorrected refractive error is an important public health issue. Cataract was the most common cause of low vision after undercorrected refractive error and is also comparatively easily treated.

The analysis also shows the great importance of age-related macular degeneration as the leading cause of blindness in Australia today. In fact, this condition causes almost half of all cases of blindness in our community. Although new treatments may help reduce the risk of blindness in some people, for most people with macular degeneration, vision loss can be neither prevented nor adequately reversed by current treatments. There is clearly a need for further research on the causes and risk factors for macular degeneration (eg, smoking), and the prevention of associated vision loss. There is also a clear need to ensure that all those with uncorrectable vision loss obtain maximum benefit from the excellent low vision services that exist in Australia.

The results of this analysis support the argument for strengthening public health education and eye health promotion messages about the need to "save your sight" and the need for regular eye examinations. They also emphasise the need to promote best professional practice for the prevention and treatment of avoidable vision loss. Data such as these have the potential to help shape our priorities for research and intervention for vision loss in Australia for the future.

## COMPETING INTERESTS

None identified.

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