Causes of Incident Visual Impairment

The Blue Mountains Eye Study

Suriya Foran, MBBS, MPH; Jie Jin Wang, MMed, PhD; Paul Mitchell, MD, PhD

Objective: To describe the causes of 5-year incident visual impairment and doubling of the visual angle in a population-based cohort.

Methods: Of the 3654 participants aged older than 50 years who participated in the Blue Mountains Eye Study (BMES I, 1992-1994), 543 died and 2335 were reexamined between 1997 and 1999 (BMES II). Visual acuity was measured using a logMAR chart before and after refraction. Pupils were dilated, and a detailed eye examination was performed. For participants with incident visual impairment or doubling of the visual angle, an ophthalmologist attributed and proportioned causes. Primary causes were defined as those responsible for 50% or more of the impairment.

Results: After refractive correction, the proportion of incident bilateral impairment worse than 20/40, worse than 20/70, and worse than 20/200 that were caused primarily by cataract decreased from 51.4% (n=19) to 40.0% (n=6) to 0%; while the proportion of cases caused primarily by age-related maculopathy increased from 24.3% (n=9) to 33.3% (n=5) to 100.0% (n=2). Similarly, the corresponding proportions of incident unilateral impairment caused primarily by cataract decreased from 53.7% (n=72) to 36.9% (n=31) to 13.6% (n=6); meanwhile, the proportion of cases caused primarily by age-related maculopathy increased from 19.4% (n=26) to 32.1% (n=27) to 54.5% (n=24). The proportions of persons with incident bilateral impairment worse than 20/40, worse than 20/70, and worse than 20/200 that could be improved with refraction were 79.4% (n=143), 73.6% (n=42), and 0%, respectively. The corresponding proportions of incident unilateral impairment improved by refraction were 66.7% (n=269), 59.0% (n=121), and 21.4% (n=12).

Conclusion: This study has documented the 5-year incidence and causes of visual impairment in an older Australian population.

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PARTICIPANTS AND METHODS

THE POPULATION STUDIED

The Blue Mountains Eye Study is a population-based survey of vision and eye diseases in an urban population aged 49 years and older, residing in 2 postal codes of the Blue Mountains region west of Sydney, Australia. A previous report from the study explained the reasons for selecting and the methods used to identify the target population, and described the population. All noninstitutionalized, permanent residents born before January 1, 1943, at the time of the census were eligible.

Of the 433 eligible residents, 3654 (82.4%) participated in the examinations from 1992 to 1994. Of the 779 persons who did not participate, 353 (45.3%) permitted only an interview, 148 (19.0%) refused, 210 (27.0%) had moved out of the area, and 68 (8.7%) had died. A previous report compared participants and nonparticipants at baseline.5 Surviving members of the cohort were invited to return for a 5-year follow-up examination conducted between 1997 and 1999. Of the 3654 persons seen at baseline, 383 (10.5%) had died. Thus, 2335 (75.1%) persons returned for a follow-up examination. Table 1 compares participants and nonparticipants.

PROCEDURES

Previous BMES reports9,11,12 describe the survey methods and procedures, which were similar for the 2 examinations. Participants provided written informed consent on both occasions. The Western Sydney Human Ethics Committee provided ethical approval.

Visual acuity was measured by a logarithm of the minimum angle of resolution (logMAR) chart, retroilluminated with automatic calibration to 85 cd/m² (Vectorvision CSV-100TM; Vectorvision Inc, Dayton, Ohio), and read at 8 ft (244 cm).9 Distance visual acuity in each eye was initially measured with current distance glasses if worn. A Humphrey autorefractor (Model 530; Humphrey-Zeiss, Dublin, Calif) provided an objective refraction. Subjective refraction was performed according to the Beaver Dam Eye Study modification of the Early Treatment Diabetic Retinopathy Study protocol.13 For each eye, visual acuity was recorded as the number of letters read correctly from 0 to 70. If no letters on the chart could be identified, visual acuity was assessed as counting fingers at 2 ft (61 cm), hand motions, light perception, or no light perception.

Applanation intraocular pressures were measured. Automated perimeter of both eyes used the Humphrey 76-point test. Persons with a hemifield defect of 5 or more points, or other suspicious features were asked to return for Humphrey 30-2 tests. Pupils were dilated, and the detailed eye examination included slitlamp (Topcon America Corp, Paramus, NJ) and retroillumination (Neitz Instrument Co, Tokyo, Japan) photographs of the lens, and stereoscopic photographs (Humphrey-Zeiss) of the optic disc and retina.

For participants with incident visual impairment or doubling of the visual angle, an ophthalmologist (P.M.) reviewed their baseline and follow-up notes and photographs and determined causes and their proportional contributions. No intraobserver study was performed to assess the reproducibility of these estimates or drift over time. We also did not attempt to validate the causes of visual impairment with other ophthalmologists. The primary cause was defined as that cause estimated to be responsible for 50% or more of the impairment or deterioration. Where amblyopia coexisted with another cause, development of visual impairment was arbitrarily assigned to the other cause. Cases with baseline amblyopia and incident impairment for which no other cause was evident were arbitrarily assigned as undetermined.

VISUAL IMPAIRMENT DEFINITIONS

Table 2 provides a summary of the definitions for persons at risk and incident cases used in this report. We defined visual impairment as worse than 20/40, based on the minimum legal visual acuity requirement for obtaining a driver’s license in Australia. This was taken in this report as fewer than 39 letters read on the logMAR chart (allowing one incorrect letter on the 20/40 line). The World Health Organization (WHO) International Classification of Diseases, 10th Revision (ICD-10) category 1 or higher defines visual impairment as worse than 20/70 in the better eye, taken as fewer than 29 letters read. The WHO ICD-10 category 2 or higher defines visual impairment as worse than 20/200, taken as fewer than 4 letters read.14 Blindness in the United States is defined by visual impairment worse than or equal to 20/200 in both eyes, taken in this report as fewer than 5 letters read. Unless otherwise specified, visual acuity refers to best-corrected acuity. Age was defined as age at the baseline examination.

Persons developed bilateral impairment if both eyes were at risk at baseline and if both eyes had incident impairment at follow-up. Persons developed unilateral impairment if both eyes were at risk at baseline and only 1 eye had incident impairment at follow-up.

In keeping with the Beaver Dam Eye Study, deterioration or doubling of the visual angle was defined as a loss of 15 letters or more read correctly at follow-up compared with baseline. An eye was considered to be at risk for deterioration if at baseline it had an acuity of light perception or better. As with unilateral and bilateral visual impairment, persons were considered to have unilateral or bilateral deterioration.

DATA HANDLING AND STATISTICAL ANALYSIS

Data were entered into dBase (Borland International Inc, Scotts Valley, Calif) for BMES I and Microsoft Access (Microsoft Corporation, Redmond, Wash) for BMES II. Statistical Analysis System (SAS Institute Inc, Cary, NC) was used for analyses, including χ² and logistic regression.

able to at least 20/40, 23 (16.1%) had also had bilateral 20/70, and 75 (52.4%) had also had unilateral visual impairment worse than 20/40 based on presenting vision at the baseline examination. Of the 42 persons with vision correctable to at least 20/70, 1 (2.4%) had also had bilateral impairment, and 12 (28.6%) had also had unilateral visual impairment worse than 20/70 based on presenting vision at the baseline examination.

Among persons at risk for incident unilateral visual impairment worse than 20/40, worse than 20/70, and
worse than 20/200, unilateral impairment occurred in 403 (18.8%), 205 (9.2%), and 56 persons (2.5%), respectively, based on their presenting vision in the better eye at the follow-up examination.

After refraction, at each of these levels of impairment, 269 (66.7%), 121 (59.0%), and 12 persons (21.4%) improved. Table 4 shows the level of visual acuity following refraction. Of the 269, 121, and 12 persons who improved, refractive correction to at least 20/40, 20/70, and 20/200 at the baseline examination was also possible in 60 (22.3%), 21 (17.4%), and 2 persons (16.7%), respectively. Table 5 and Table 6 show the breakdown by age and level of visual impairment of persons with unilateral impairment worse than 20/40.

AGE-SPECIFIC CAUSES OF INCIDENT VISUAL IMPAIRMENT WORSE THAN 20/40

Table 5 shows the age-specific causes of incident unilateral impairment worse than 20/40. Overall, the primary causes were cataract (53.7%) and age-related macular degeneration (ARM) (19.4%). In the age groups 49 to 59 years, 60 to 69 years, 70 to 79 years, and older than 80 years, cataract was the primary cause in 41.7%, 58.7%, 49.2%, and 69.2% of cases, respectively; meanwhile, ARM was responsible for 8.3%, 15.2%, 23.8%, and 23.1% of cases, respectively. Other retinal disorders and retinal vascular occlusions were jointly the next most frequent cause of incident visual impairment.

CAUSES OF INCIDENT UNILATERAL VISUAL IMPAIRMENT

Unilateral Visual Impairment (<20/40-20/70)

Table 6 presents the causes of unilateral visual impairment worse than 20/40, and the 3 subsets worse than 20/40 to 20/70, worse than 20/70 to 20/200, and worse than 20/200. After refraction, 81 persons had incident visual impairment worse than 20/40; 52 were women (64.2%), and 29 were men (35.8%). Of these persons, 5 (6.2%) were aged between 49 and 59 years, 34 (42.0%) were aged between 60 and 69 years, and 43 (53.0%) were aged between 70 and 79 years. Cataract was the primary cause in 52 persons (64.2%), 2 of whom had postcataract surgical complications (posterior capsular opacity). Age-related macular degeneration was the primary cause in 11 persons (13.6%). Additional primary causes included other retinal disease, glaucoma, retinal vascular occlusion, corneal disease, and diabetic retinopathy.
Unilateral Visual Impairment
(>20/70-20/200, WHO ICD-10 Category 1)

Of the 32 persons with incident unilateral visual impairment worse than 20/70 to 20/200, 18 were women (56.3%), 14 were men (43.7%). Five persons (15.6%) were aged between 49 and 59 years, 9 (28.1%) were aged between 60 and 69 years, 15 (46.7%) were aged between 70 and 79 years, and 3 (9.4%) were older than 80 years. Cataract was the primary cause in 16 persons (50.0%), 1 of whom had posterior capsular opacity. Age-related macular degeneration was the primary cause in 4 persons (12.5%). Additional primary causes included other retinal disease, retinal vascular occlusion, glaucoma, and corneal disease.

Table 3. Primary Causes of Incident Bilateral Visual Impairment Worse Than 20/40, Worse Than 20/70, and Worse Than 20/200 Following Subjective Refraction*

<table>
<thead>
<tr>
<th></th>
<th>&lt;20/40 (No. at Risk = 2142)</th>
<th>&lt;20/70 (No. at Risk = 2231)</th>
<th>&lt;20/200 (No. at Risk = 2284)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons with impairment</td>
<td>180 (8.4)</td>
<td>57 (2.6)</td>
<td>2 (0.1)</td>
</tr>
<tr>
<td>Correctable with refraction (better eye)</td>
<td>143 (6.7)</td>
<td>421 (1.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Noncorrectable with refraction</td>
<td>37 (1.7)</td>
<td>15 (0.7)</td>
<td>2 (0.1)</td>
</tr>
</tbody>
</table>

Primary cause in noncorrectable cases

Same cause in right and left eye
- Cataract: 19 (51.4) 6 (40.0) 0 (0.0)
- Age-related maculopathy: 9 (24.3) 5 (33.3) 2 (100.0)
- Other retinal: 1 (2.7) 0 (0.0) 0 (0.0)

Different causes in right and left eye
- ARM, cataract: 2 (5.4) 0 (0.0) 0 (0.0)
- Cataract, retinal vascular occlusion: 1 (2.7) 1 (6.7) 0 (0.0)
- ARM, other retinal pathology: 1 (2.7) 1 (6.7) 0 (0.0)
- ARM, glaucoma: 1 (2.7) 1 (6.7) 0 (0.0)
- Optic neuropathy, corneal disease: 1 (2.7) 1 (6.7) 0 (0.0)
- Cataract, other retinal pathology: 1 (2.7) 0 (0.0) 0 (0.0)
- Cataract, undetermined: 37 (100.0) 15 (100.0) 2 (100.0)

*All data are presented as number of persons with incident bilateral impairment (percentage). ARM indicates age-related macular degeneration.
†All 143 participants corrected to no visual impairment (>20/40).
‡Of these 42 participants, 28 corrected to no visual impairment, and 14 to <20/40-20/70.

Table 4. Primary Causes of Incident Unilateral Visual Impairment Worse Than 20/40, Worse Than 20/70, and Worse Than 20/200 Following Subjective Refraction*

<table>
<thead>
<tr>
<th></th>
<th>&lt;20/40 (No. at Risk = 2142)</th>
<th>&lt;20/70 (No. at Risk = 2231)</th>
<th>&lt;20/200 (No. at Risk = 2284)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons with impairment (better eye)</td>
<td>403 (18.8)</td>
<td>205 (9.2)</td>
<td>56 (2.5)</td>
</tr>
<tr>
<td>Correctable with refraction</td>
<td>269 (12.6)</td>
<td>121 (5.4)</td>
<td>125 (0.3)</td>
</tr>
<tr>
<td>Noncorrectable with refraction</td>
<td>134 (6.3)</td>
<td>84 (3.8)</td>
<td>14 (0.5)</td>
</tr>
</tbody>
</table>

Primary cause, noncorrectable cases

<table>
<thead>
<tr>
<th></th>
<th>&lt;20/40 (No. at Risk = 2142)</th>
<th>&lt;20/70 (No. at Risk = 2231)</th>
<th>&lt;20/200 (No. at Risk = 2284)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>72 (53.7)</td>
<td>31 (36.9)</td>
<td>6 (13.6)</td>
</tr>
<tr>
<td>ARM</td>
<td>26 (19.4)</td>
<td>27 (32.1)</td>
<td>24 (54.5)</td>
</tr>
<tr>
<td>Other retinal pathology</td>
<td>14 (10.4)</td>
<td>8 (9.5)</td>
<td>2 (4.5)</td>
</tr>
<tr>
<td>Retinal vascular occlusion</td>
<td>7 (5.2)</td>
<td>5 (6.0)</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>4 (3.0)</td>
<td>2 (2.4)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Corneal disease</td>
<td>4 (3.0)</td>
<td>2 (2.4)</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (2.2)</td>
<td>2 (2.4)</td>
<td>4 (9.1)</td>
</tr>
<tr>
<td>Undetermined</td>
<td>4 (3.0)</td>
<td>7 (8.3)</td>
<td>3 (6.8)</td>
</tr>
<tr>
<td>Total</td>
<td>134 (100.0)</td>
<td>84 (100.0)</td>
<td>44 (100.0)</td>
</tr>
</tbody>
</table>

*All data are presented as number of participants (percentage). ARM indicates age-related macular degeneration.
†All 269 persons corrected to no visual impairment (>20/40). 60 of whom were undercorrected (<20/40) at baseline.
‡Of the 121 persons, 72 corrected to no visual impairment and 49 to <20/40-20/70; 21 were undercorrected (<20/70) at baseline.
§Of the 12 persons, 3 corrected to no visual impairment and 9 to <20/70-20/200; 2 were undercorrected (<20/200) at baseline.
|Cataract includes postcataract surgical complications; other includes diabetic retinopathy, optic neuropathy, eye injury, and enucleation.

Unilateral Visual Impairment
(>20/200, WHO ICD-10 Category 2 or Worse)

Of the 21 persons with incident unilateral visual impairment worse than 20/200, 16 (76.2%) were women and 5 (23.8%) were men. Two persons (9.5%) were aged between 49 and 59 years, 3 (14.3%) were aged between 60 and 69 years, 13 (61.9%) were aged between 70 and 79 years, and 3 (14.3%) were older than 80 years. Age-related macular degeneration was the primary cause in 11 persons (52.4%). Cataract was the primary cause in 4 persons (19.0%), 1 of whom had posterior capsular opacity. Additional primary causes were retinal vascular occlusion, corneal disease, optic neuropathy, and enucleation after trauma.
Nonexclusive Visual Impairment Categories

Table 3 and 4 present the primary causes for the 3 overlapping incident bilateral and unilateral visual impairment categories (<20/40, <20/70, and <20/200, respectively). They show that the proportions of participants with cataract as the primary cause of incident impairment decrease with increasing severity of visual impairment, while the proportions of cases with ARM as the primary cause of incident impairment increase with increasing severity of visual impairment.

VISUAL IMPAIRMENT
(≤20/200, US DEFINITION OF BLINDNESS)

Applying the US definition for blindness (≤20/200) identified no more persons than the 2 with incident bilateral visual impairment worse than 20/200 as shown in Table 3. An identical number of cases of incident unilateral impairment were found at these 2 levels (44 persons), and there were the same proportions due to ARM and cataract. Only minor differences were seen for additional causes.

DOUBLING OF THE VISUAL ANGLE (DETERIORATION)

Doubling of the visual angle (a decrease of 15 or more letters read correctly) occurred bilaterally in 31 persons (1.3%) and unilaterally in 149 persons (6.4%). Of the 31 persons with bilateral visual angle doubling, 23 (74.2%) also developed incident bilateral visual impairment. The primary cause in both eyes was ARM in 12 participants (38.7%) and cataract in 10 (32.2%). Combined cataract and/or ARM developed in 29 persons (93.5%).

Of the 149 persons with incident unilateral deterioration, 129 persons (86.6%) had no visual impairment in that eye at baseline and 9 (6.0%) had preexisting severe visual impairment. Concurrent incident visual impairment were found at these 2 levels (44 persons), and there were the same proportions due to ARM and cataract. Only minor differences were seen for additional causes.
ment developed in 116 participants (77.9%). The primary cause was cataract in 61 persons (40.9%) and posterior capsular opacity in 4 persons (2.7%). Age-related macular degeneration was the primary cause in 38 persons (25.5%). Additional principal causes included other retinal pathology in 18 persons (12.1%), retinal vascular occlusion in 7 (4.7%), glaucoma in 5 (3.4%), corneal disease in 3 (2.0%), eye injury in 3 (2.0%), and enucleation in 2 (1.3%). Optic neuropathy, diabetic retinopathy, and neurological pathology were causal in 1 person (0.7%) each. Causes were undetermined in 5 persons (3.4%).

A better understanding of changes in the underlying causes of visual impairment over time among older persons will be important in the development of strategies that could reduce both the incidence and the various impacts of visual impairment.\footnote{15-19} It could also provide a basis for prioritizing research activity, which may be a relevant consideration with current population aging trends. Although data on incident blindness may be derived indirectly from blind registries, these are known substantially to underestimate the number of elderly persons affected and can provide information only about severe levels of visual impairment.

To our knowledge, no data providing a detailed analysis of the causes of incident visual impairment from large, older population-based samples have been reported previously. Comparison of our data with reported prevalence findings on the causes of visual impairment from large, population-based cross-sectional studies, including our own,\footnote{20} would be useful in confirming the frequency of specific diseases leading to incident visual impairment.

In keeping with previously reported data from the BMES\footnote{20} and several other studies, we\footnote{21} our findings confirmed cataract and ARM as the 2 principal causes of incident bilateral visual impairment after refraction. Cataract was the principal cause of incident visual impairment worse than 20/40, while ARM was increasingly important as the principal cause of the 2 more severe levels of incident visual impairment worse than 20/70 and worse than 20/200. In the BMES baseline examination, ARM was the predominant cause of bilateral moderate (20/80-20/200) and severe visual impairment (< 20/200) in persons aged 70 years or older.\footnote{20} Cataract was the most frequent cause of bilateral mild impairment (<20/40-20/70).

Other cross-sectional population-based studies have also assessed the causes of visual impairment and blindness following refraction. The Baltimore Eye Survey reported in a multiracial US community aged 40 years or older that cataract was the leading cause of visual impairment (<20/20 to >20/200), followed by ARM, then diabetic retinopathy and glaucoma.\footnote{1} The leading causes of blindness (<20/200) were cataract, glaucoma, and ARM.\footnote{21} The more recent Salisbury Study\footnote{2} examined persons aged 65 to 84 years and defined visual impairment and blindness using similar criteria to Baltimore.\footnote{2} The leading causes of visual impairment were cataract, then ARM, diabetic retinopathy, and glaucoma. Blindness was caused by ARM (43%), followed by optic atrophy, diabetic retinopathy, glaucoma, and trauma. In the Rotterdam Study, the leading causes of visual impairment (<20/60 to ≤20/400) among persons aged 55 years or older were cataract, followed by ARM, then myopic retinal degeneration.\footnote{3} Blindness (<20/400) was predominantly due to ARM (in 58% of blind eyes), followed by glaucoma, cataract, and myopic retinal degeneration.

It is likely that some of the differences found in these cross-sectional studies of visual impairment may be due to the inherent difficulty in determining the cause(s) of visual impairment and their proportional contribution. Attributing the causes of visual impairment is a difficult and potentially imprecise exercise, particularly when lens opacity obscures a clear view of the macula or optic disc. Estimating the proportional contribution to visual impairment when more than one cause is present, or when only minimal visual impairment develops, can be especially difficult. Attribution of cause is inherently subjective, so our estimates need to be viewed with caution. In our study, we could not attribute the cause of visual impairment or deterioration in approximately 3% of cases. The variability in the causes of blindness also reflects the relatively small number of blind participants in each of these studies. The development of cognitive impairment could also have influenced the assessment of visual impairment. Although we measured cognitive impairment with the Mini-Mental State Examination, we have not yet explored this possible association.

Two recent reports from the Visual Impairment Project (VIP) from Melbourne, Australia, highlighted the high frequency of undercorrected or uncorrected refractive error as a cause of visual impairment in older persons.\footnote{8,22} This study examined persons 40 years or older and assessed the causes of visual impairment (<20/40) and blindness (either <20/200 or <20/400) for both presenting best-corrected visual acuity and visual acuity at initial visit. Many visual field criteria were incorporated into each level of impairment. Undercorrected or uncorrected refraction was the leading cause of visual impairment (58%). Nonrefractive causes of visual impairment, however, were similar to those reported by most other studies. These included ARM, followed by cataract, glaucoma, neurological causes, and diabetic retinopathy. Age-related macular degeneration and glaucoma were equal principal causes of both levels of blindness in this study.\footnote{22}

In our study, undercorrected refraction was frequently associated (in approximately 75% of cases) with incident bilateral visual impairment (based on presenting visual acuity at initial visit) at lower levels of visual impairment, worse than 20/40 and worse than 20/70, but it was not associated with incident blindness (Table 3). After refractive correction, the leading cause of incident bilateral visual impairment worse than 20/40 was cataract, followed by ARM. Following refraction, ARM and cataract each caused or contributed to a similar proportion of cases (46.7%) of incident bilateral visual impairment worse than 20/70. Age-related macular degeneration caused each of the 2 cases with incident bilateral visual impairment worse than 20/200. The proportion of incident cases with unilateral impairment worse than 20/40, worse than 20/70, and worse than 20/200 that could be improved with refraction declined with increasing severity of impairment.
older persons. These have included effects on the use of live independently resulting from visual impairment in different impacts on daily living activities and ability to uncorrected refraction was also associated with substantial disease causing visual impairment. Undercorrected refraction seems to play a potentially important role as a frequent associated factor that could be readily addressed. Appropriately targeted refractive services could substantially reduce the morbidity from visual impairment in this age group.

This study has confirmed that undercorrected refraction is often associated with incident visual impairment, as recent prevalence findings from the Visual Impairment Project (Victoria, Australia) and our previous report suggest. Our study and others have described many different impacts on daily living activities and ability to self-rated health. Most studies have assessed the impacts from noncorrectable visual impairment; however, in several recent reports, visual impairment associated with uncorrected refraction was also associated with substantial impacts, though generally at a lower magnitude.

At the baseline examination, persons whose vision improved by 1 or more lines following refraction were advised by the examining physician, and later in the examination report, that their vision could be improved by glasses or a change in their distance glasses if worn. Around 20% of participants whom we classified as developing incident unilateral visual impairment correctable with refraction (based on their best-corrected visual acuity at baseline and presenting visual acuity at follow-up) were not true incident cases because they had also had correctable visual impairment at the baseline examination. Many people with undercorrected refraction do not feel they need, or dislike wearing, distance glasses. Many stated that they had distance glasses but did not wear them. Thus, while simple optical measures may correct a large proportion of visual impairments, people may not feel the need for these (particularly if one eye is unimpaired) until other abnormalities intervene. Nevertheless, the accumulating evidence regarding impacts of undercorrected refraction on independent living indicate the potential public health importance of refractive correction.

The BMES examined 75.1% of survivors from the initial study after 5 years. A potential limitation of our study is that we may have underestimated the decrease in visual acuity or the incidence of visual impairment because persons returning had significantly less visual impairment and late ARM at baseline than nonparticipants, as indicated in Table 1.

This report confirmed ARM as the preeminent cause of moderate to severe incident visual impairment in an older white population. Cataract was the principal remediable disease causing visual impairment. Undercorrected refraction seems to play a potentially important role as a frequent associated factor that could be readily addressed. Appropriately targeted refractive services could substantially reduce the morbidity from visual impairment in this age group.

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Corresponding author and reprints: Paul Mitchell, MD, PhD, Department of Ophthalmology, University of Sydney, Hawkesbury Road, Westmead, New South Wales, Australia 2145 (e-mail: paulm@westgate.wah.usyd.edu.au).

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