Homonymous Visual Field Defects and Stroke in an Older Population

Jagjit Singh Gilhotra, MBBS; Paul Mitchell, MD, PhD; Paul R. Healey, MBBS, FRACO; Robert G. Cumming, MBBS, PhD; Jon Currie, MBBS, FRACP

Purpose—The objective of the present study was to describe the prevalence of homonymous visual field defects in a defined older urban population and associations with self-reported stroke.

Methods—Homonymous visual field defects were assessed from screening automated visual field tests of both eyes in 3654 persons aged ≥49 years who were participating in the Blue Mountains Eye Study. This represented 82.4% of eligible residents from a defined area west of Sydney, Australia. A detailed eye examination was performed, and the medical history was taken. Masked grading of visual fields was used to classify the presence of homonymous visual field defects.

Results—Homonymous visual field defects were found in 25 persons (prevalence 0.8%, 95% CI 0.5% to 1.1%). Stroke history was reported by 194 participants (5.3%, 95% CI 4.6% to 6.1%). A strong relationship was found between homonymous visual field defects and history of stroke, age-, and sex-adjusted odds ratio (OR) 23.4 (95% CI 9.9 to 55.7). Homonymous field defects were present in 8.3% of all persons who reported experiencing a stroke. Among those with homonymous field defects, 52% reported a history of stroke. Only 2 of 10 persons (20%) with homonymous field defects without a history of stroke reported having stopped driving, whereas 6 of 9 (67%) reporting stroke had stopped driving (P=0.07). Increasing age (OR 1.4 per decade, 95% CI 1.2 to 1.8) was significantly associated with homonymous visual field defects, with adjustment for sex, whereas a history of hypertension (OR 2.7, 95% CI 1.2 to 6.1), diabetes (OR 2.1, 95% CI 1.4 to 3.2), and renal impairment (OR 2.8, 95% CI 1.0 to 8.1) also was associated, with adjustment for age and sex.

Conclusions—This study provides accurate prevalence data for homonymous visual field defects in an older population. About half the participants did not report stroke. (Stroke. 2002;33:2417-2420.)

Key Words: blindness ■ epidemiology ■ prevalence ■ stroke assessment ■ stroke outcome ■ visual disorders ■ visual fields

Although stroke is the third most common cause of death in Western communities,1,2 it also is the most common cause of disability in adults3,4 and is the leading cause of both long- and short-stay hospital admissions.5 As the incidence of stroke rises exponentially with age5,6 and as stroke patients survive longer,7 changing population demographics mean that stroke will likely consume an increasing share of resources to manage related disabilities. However, to date, the visual disability caused by stroke has received little attention in population-based studies. Homonymous visual field deficits after stroke have been associated with an adverse functional prognosis.8,9 To our knowledge, however, no population-based studies have examined the prevalence of homonymous visual field defects and their relationship to stroke. This information would be useful in planning health services, because visual field loss caused by stroke is a relevant component of stroke-related disability.

Our aim in the present study to (1) estimate the prevalence of homonymous visual field defects in an older population, (2) determine their relationship to self-reported stroke, and (3) investigate associations between homonymous visual field defects and factors associated with risk of stroke.

Methods

Study Population

The study population has been described previously.10 The Blue Mountains Eye Study is an Australian population-based survey of vision and common eye diseases in an urban elderly community aged ≥49 years and residing in 2 postal codes west of Sydney. The area is geographically well defined, and the community is reasonably representative of the Australian urban population for age and measures of socioeconomic status. The population was identified in a door-to-door census of all dwellings. Of 4433 age-eligible residents, 3654 (82.4%) participated, including 2072 women (56.7%) and 1582 men (43.3%), with a mean age of 65.9 years. Among 779 nonparticipants, 68 (1.5%) died and 210 (4.8%) moved from the area during the study period, whereas 501 (11.3%) refused to participate.10 The study was approved by the Western Sydney Area Health Service Human Ethics Committee, and written, informed consent was obtained from all participants.

Procedures

At the local clinic, a detailed demographic and medical history was taken, including a physician-made diagnosis of diabetes, hyperten-
sion, or vascular events, such as episodes of angina or acute myocardial infarction, and the earliest age at diagnosis. To determine a history of stroke, we asked, “Has a doctor ever said that you had a stroke?” Smoking history also was determined. Subjects were asked to return for fasting blood tests that included glucose and lipids. Diabetes was diagnosed on the basis of the history or the presence of elevated fasting blood glucose (≥7.0 mmol/L).

Participants underwent a detailed eye examination that included a dilated fundus examination with 30-degree stereo retinal photographs and lens photographs. Visual fields of both eyes were assessed with automated perimetry (Humphrey 76-point suprathreshold screening test; Humphrey Instruments, Inc). A masked grading of the visual field printouts of both eyes was performed by a single grader. Participants were then classified as having either no homonymous defect or a “definite” or “probable” homonymous defect. These defects were further classified as representing complete hemianopia or quadrantanopia and incomplete homonymous defects. Persons with a generalized pattern of points missing in the visual fields of both eyes were classified as having no homonymous defect. Nonstroke causes of an homonymous field defect pattern were also considered if matching the field defect, such as retinal vein occlusion, tilted optic discs, or glaucomatous optic neuropathy. These cases were adjudicated and excluded.

Statistical Analysis
Statistical Analysis System (SAS Institute Inc) was used. Mantel-Haenszel χ² tests for trend were used to assess nondichotomous variables, and the 2-tailed Fisher exact test was used for variables with small cell frequencies. Continuous data were tested for linearity, and an age- and sex-adjusted logistic regression model developed. Effect modification (age and smoking history) was assessed. Odds ratios (OR) and 95% CI values are given.

Results
Automated visual field testing was completed by 3243 participants (89% of those examined). Reasons for not completing automated visual fields were poor vision (9%), difficulty comprehending the test (12%), physical disabilities (6%), examination in the home (10%), unwillingness to stay for the full examination (32%), and machine breakdown (31%). Subjects who completed the visual field examination were younger (mean age 65.7 years) than those who did not complete the field test (mean age 70.2 years) and were slightly more likely to report a history of stroke (5% versus 9%) or diabetes (7% versus 9%). Of those who completed reliable visual fields, 38 of 194 (19.6%) had missing fields compared with 373 of 3440 (10.8%) subjects without a history of stroke (P<0.001).

A definite or probable homonymous visual field defect was found in 25 subjects, for a prevalence of 0.8% (95% CI 0.5% to 1.1%). The prevalence rate rose with increasing age, from 0.4% of subjects aged <60 years to 1.1% of subjects aged ≥70 years (Table 1). However, this trend was not statistically significant. Nine subjects had complete hemianopia (6 right, 3 left), 8 subjects had quadrantanopia (4 right, 4 left), and 8 subjects had incomplete quadrantanopia (n=7) or hemianopic (n=1) defects (3 right, 5 left). Of the 25 homonymous defects, 19 were congruous.

A physician-diagnosed history of stroke was given by 194 of 3634 subjects with complete history data, for a prevalence of 5.3% (95% CI 4.6% to 6.1%), and included 97 of 1573 men (prevalence 6.2%) and 97 of 2061 women (prevalence 4.7%). Stroke prevalence was strongly age related, increasing from 1.2% in subjects aged <60 years to 10.8% of subjects aged ≥80 years (P<0.001) (Table 2).

Reliable visual field testing was completed by 156 of 194 subjects (80.4%) with a history of stroke and by 3071 of 3440 subjects (89.3%) without a history of stroke. Of those who completed reliable visual fields, 13 of 156 (8.3%) with a history of stroke had homonymous visual field defects compared with 12 of 3071 (0.4%) of those without a history of stroke (age- and sex-adjusted OR 23.4, 95% CI 9.9 to 55.7). Thus, only 13 of 25 subjects (52%) with homonymous field defects gave a history of stroke. The homonymous field defects were asymptomatic in all subjects without history of stroke, whereas 3 (30%) of those giving a history of stroke were aware of their field defect.

Only 1 of 12 subjects (9%) with an homonymous field defect without a history of stroke was taking aspirin regularly compared with 7 of 13 subjects (54%) with field defects and previously reported stroke (Fisher’s exact test P=0.03). Of the 25 persons with homonymous visual field defects, 6 had never driven, 7 had stopped driving, and 12 stated that they were still driving. Of those not reporting a history of stroke, only 2 of 10 (20%) had stopped driving compared with 6 of 9 (67%) with a history of stroke (Fisher’s exact test, P=0.07). Only 1 of 12

### TABLE 1. Prevalence of Homonymous Visual Field Defects by Age

<table>
<thead>
<tr>
<th>Group, y</th>
<th>At Risk, n</th>
<th>Homonymous Visual Field Defects, n</th>
<th>Prevalence, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>49–59</td>
<td>935</td>
<td>4</td>
<td>0.4 (0.1–1.1)</td>
</tr>
<tr>
<td>60–69</td>
<td>1167</td>
<td>9</td>
<td>0.7 (0.41–1.5)</td>
</tr>
<tr>
<td>70–79</td>
<td>852</td>
<td>9</td>
<td>1.1 (0.5–2.0)</td>
</tr>
<tr>
<td>≥80</td>
<td>262</td>
<td>3</td>
<td>1.1 (0.2–3.3)</td>
</tr>
<tr>
<td>All</td>
<td>3216</td>
<td>25</td>
<td>0.8 (0.5–1.1)</td>
</tr>
</tbody>
</table>

### TABLE 2. Prevalence of Self-Reported Stroke by Age and Sex

<table>
<thead>
<tr>
<th>Group, y</th>
<th>At Risk, n</th>
<th>Self-reported Stroke, n*</th>
<th>Prevalence, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49–59</td>
<td>443</td>
<td>5</td>
<td>1.1 (0.4–2.6)</td>
</tr>
<tr>
<td>60–69</td>
<td>586</td>
<td>34</td>
<td>5.8 (4.1–8.8)</td>
</tr>
<tr>
<td>70–79</td>
<td>399</td>
<td>43</td>
<td>10.8 (7.9–14.2)</td>
</tr>
<tr>
<td>≥80</td>
<td>144</td>
<td>15</td>
<td>10.4 (5.9–16.6)</td>
</tr>
<tr>
<td>Overall</td>
<td>1572</td>
<td>97</td>
<td>6.2 (5.0–7.5)</td>
</tr>
</tbody>
</table>

| Women    |            |                         |                        |
| 49–59    | 573        | 7                       | 1.2 (0.5–2.5)          |
| 60–69    | 715        | 19                      | 2.7 (1.6–4.1)          |
| 70–79    | 555        | 47                      | 8.5 (6.3–11.1)         |
| ≥80      | 218        | 24                      | 11.0 (7.2–15.9)        |
| Overall  | 2061       | 97                      | 4.7 (3.8–5.7)          |

| All      |            |                         |                        |
| 49–59    | 1016       | 12                      | 1.2 (0.6–2.1)          |
| 60–69    | 1301       | 53                      | 4.1 (1.1–5.3)          |
| 70–79    | 954        | 90                      | 9.4 (7.7–11.5)         |
| ≥80      | 362        | 39                      | 10.8 (7.8–14.4)        |
| Overall  | 3634       | 194                     | 5.3 (4.6–6.1)          |

*Twenty missing.
persons still driving had an hemianopia. The remaining 11 had homonymous quadrantanopias, most of which were incomplete.

Univariate analysis indicated statistically significant associations between homonymous visual field defects and both hypertension and renal impairment. Increasing age (OR 1.4, 95% CI 1.2 to 1.8 per decade), history of hypertension (OR 2.7, 95% CI 1.6 to 6.1), diabetes (OR 2.1, 95% CI 1.4 to 3.2), and renal impairment (OR 2.8, 95% CI 1.0 to 8.1), after adjustment for age and sex, were associated with an increased risk of homonymous visual field defects, as shown in Table 3. In a multivariate model, history of stroke was also statistically significantly associated with increasing age (OR 2.0, 95% CI 1.7 to 2.4 per decade), history of hypertension (OR 2.8, 95% CI 2.0 to 3.9), and diabetes (OR 2.0, 95% CI 1.3 to 3.1). Women were less likely than men to give a history of stroke (OR 0.7, 95% CI 0.5 to 0.9).

However, 2 methodological considerations that could have influenced our results are the potential for inadequate case ascertainment of both homonymous visual field defects and stroke and the diagnostic accuracy of self-reported stroke. Overall, 11% of the subjects in our study did not complete visual field testing, and the proportion of subjects with missing fields increased with age. It therefore is possible that a small, additional number of subjects may have had stroke-related disabilities that precluded them from undergoing visual field testing, thus providing an underestimation of the prevalence of homonymous visual field defects. If present, this effect is likely to have been greater for subjects who reported stroke (19.6% missing fields) than for those with no history of stroke (10.7% missing fields) (P<0.001). Furthermore, subjects with combined stroke and visual field defects may have been more likely to require nursing home admission than were subjects without these signs and so would not have been included in our survey.

Within these constraints, it therefore is of note that the self-reported stroke prevalences among women (4.7%) and men (6.2%) in our study are similar to those reported from comparable population-based studies, including the Rotterdam study (4.3% and 5.0% for women and men aged ≥55 years)\textsuperscript{11} and the Auckland\textsuperscript{7} and North Yorkshire\textsuperscript{13} studies.

The increasing age-related prevalence of self-reported stroke found for both men and women in our study supports the accuracy of our case ascertainment.\textsuperscript{7,11,13} Other studies have previously reported high diagnostic accuracy (95% sensitivity and 96% specificity) for the question, “Have you ever had a stroke?”\textsuperscript{15,17}

The 0.8% prevalence rate in the present study for homonymous visual field defects in a noninstitutionalized general population aged ≥49 years is similar to the 0.5% (17 of 3250) prevalence rate reported in the Melbourne Visual Impairment Project for hemianopic or quadrantanopic defects.\textsuperscript{14} The North Yorkshire study\textsuperscript{13} described stroke-related visual deficits in 0.5% and 0.7% of right eyes and left eyes, respectively, in a population of 18827 persons aged ≥55 years.

## Table 3. Age- and Sex-Adjusted Analysis of Relationship Between Homonymous Visual Field Defects and Vascular Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>With Homonymous Visual Field Defects, n (%)</th>
<th>Without Homonymous Visual Field Defects, n (%)</th>
<th>Homonymous Visual Field Defects (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, per 10 y*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female†</td>
<td>14/25 (56)</td>
<td>1811/3207 (56)</td>
<td>1.4 (1.2–1.8)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>16/25 (64)</td>
<td>1235/3210 (38)</td>
<td>2.7 (1.2–6.1)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2/25 (8)</td>
<td>217/3216 (7)</td>
<td>2.1 (1.4–3.2)</td>
</tr>
<tr>
<td>Renal impairment</td>
<td>5/25 (20)</td>
<td>229/3216 (7)</td>
<td>2.8 (1.0–8.1)</td>
</tr>
<tr>
<td>Angina</td>
<td>3/24 (13)</td>
<td>399/3204 (13)</td>
<td>0.9 (0.3–2.9)</td>
</tr>
<tr>
<td>Acute myocardial infarct</td>
<td>1/24 (4)</td>
<td>299/3202 (9)</td>
<td>0.4 (0.1–2.7)</td>
</tr>
<tr>
<td>Elevated serum cholesterol</td>
<td>12/25 (48)</td>
<td>2063/3216 (64)</td>
<td>0.5 (0.2–1.1)</td>
</tr>
<tr>
<td>Current smoking</td>
<td>12/24 (50)</td>
<td>1126/3111 (36)</td>
<td>2.1 (0.8–5.3)</td>
</tr>
<tr>
<td>Past smoking</td>
<td>4/24 (17)</td>
<td>472/3111 (15)</td>
<td>1.9 (0.6–6.6)</td>
</tr>
</tbody>
</table>

*Adjusted for sex only.
†Adjusted for age only.

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**Discussion**

Many population-based studies have provided data on the prevalence and incidence of stroke and associated disability.\textsuperscript{7,11–13} However, few have described the prevalence of stroke-related visual disability, which may include homonymous visual field loss. The prevalence of stroke-related visual impairment was reported for “right eyes” and “left eyes” in an older North Yorkshire, UK, population,\textsuperscript{13} but it is unclear whether this referred to homonymous visual field loss on the affected side. To our knowledge, the Melbourne Visual Impairment Project provides the only previous population-based data on the prevalence of hemianopic or quadrantanopic defects (0.5%),\textsuperscript{14} but this report also did not specifically state that these field defects were homonymous. We believe that our study may be the first to report population-based prevalence of homonymous visual field defects and their relationship to stroke. Our cross-sectional survey with a high participation rate provides a considerable advantage in determining the prevalence of chronic conditions such as stroke and of low-frequency events such as homonymous field defects,\textsuperscript{15} because many patients with stroke are not admitted to hospital.\textsuperscript{5,16}
An additional consideration is that although our visual field testing strategy is reasonably accepted to detect neuro-ophthalmic disease,15 automated visual field testing may produce larger and more incongruous homonymous visual field defects than previous manual visual field tests.19

An important finding in the present study was that almost half (48%) of the subjects with homonymous field defects did not report a history of stroke. Although a number of disease processes, such as tumor, trauma, infection, or congenital lesions, can cause homonymous visual field defects,20 it is recognized that in 40% to 90% of patients with isolated homonymous visual field defects, the underlying cause is cerebrovascular ischemia in the territory of the posterior cerebral artery.20–22 We were able to confirm 7 head CT scan reports for the 25 subjects with homonymous visual field defects. Five were consistent with an occipital infarct on the appropriate side, 1 was reported as showing deep white matter ischemia, and 1 demonstrated a cerebral aneurysm that had been clipped.

Of further clinical relevance, embolism is the most common cause of posterior cerebral artery ischemia and occipital lobe infarction,23 including cardiac and local artery to artery mon cause of posterior cerebral artery ischemia and occipital cerebral aneurysm that had been clipped.24

showing deep white matter ischemia, and 1 demonstrated a occipital infarct on the appropriate side, 1 was reported as aspirin regularly for secondary stroke prevention.24

In the present study, 8.3% of subjects with self-reported stroke had homonymous visual field defects, which is somewhat less than the reported rate of visual deficits (13% to 20% of subjects) for persons with early neurological manifestations caused by stroke in a large health maintenance organization population from Portland.25

The negative impact of homonymous visual field defects on driving skills has been well reported,26 so in most countries, persons with these field defects (both hemianopias and quadrantanopias) are restricted from holding a driver’s license. The high proportion of subjects with homonymous field defects (mainly incomplete quadrantanopias) who were still driving, particularly among those without a history of stroke, is cause for concern.

This study demonstrated statistically significant associations between homonymous visual field defects and age, hypertension, diabetes, and renal impairment. The first 3 of these factors have consistently been associated with stroke.1,27–29

Stroke is a common problem in elderly persons that leads to major disability, and homonymous visual field defects have been associated with an adverse prognosis for functional outcome. Our study provides new data on the prevalence of homonymous visual field loss and its relationship to stroke in a general older population. Importantly, only around half of those with homonymous visual field defects reported a history of stroke, most were asymptomatic, and a surprisingly high proportion were still driving.

Acknowledgments

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References


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