# Visual Impairment, Causes of Vision Loss, and Falls: The Singapore Malay Eye Study

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**Purpose.** To report associations of visual impairment and the main causes of vision loss with falls in an older Asian population.

**Methods.** The population-based Singapore Malay Eye Study examined 3280 (78.7% response rate) Malay adults 40 to 80 years of age. Details about any fall in the previous 12 months and personal and sociodemographic information were collected. Presenting visual acuity (PVA) was measured. Mild or moderate visual impairment (0.3 < logMar < 1.0), severe visual impairment (logMAR ≥ 1.0), and the primary causes of visual impairment were determined by ophthalmologists at examination.

**Results.** Of the 3280 participants, 3266 (99.6%) provided information about falls. Of these, 14.7% ($n$ = 480) reported having fallen in the past 12 months. After adjustment for gender, age, body mass index, history of angina, heart attack, stroke, hypertension, diabetes, and self-rated health, the results showed that severe visual impairment in the worse eye significantly increased the risk of falling (60%; OR = 1.6; 95% CI 1.1 to 2.3). Severe visual impairment in one eye and mild or moderate visual impairment in the other also doubled the risk of falls (OR = 2.1; 95% CI 1.4–3.1). Having glaucoma ($n$ = 21) increased the risk of falling by more than fourfold (OR = 4.2; 95% CI 1.2–12.3) after adjustment for visual acuity. Although mild or moderate visual impairment was not significantly associated with falls, odds ratios tended toward the direction of risk.

**Conclusions.** Findings from this Asian population provide further evidence in support of the association between severe visual impairment and falls in older persons. (*Invest Ophthalmol Vis Sci.* 2008;49:528–533) DOI:10.1167/iovs.07-1036

Falls are the leading cause of injury-related death among elderly individuals[1,2] and annually affect one in three community-living elderly individuals.[3–6] Falls can result in restriction of mobility and activity, feelings of helplessness, loss of confidence, depression, and institutionalization.[7] The healthcare costs of falls are pervasive and substantial and correlate with the frequency and severity of falls.[8]

Although falls have a multifactorial etiology,[9] a commonly cited cause of falls in older people is poor vision. In this regard, several population-based studies have identified poor vision as one of the most frequent risk factors for falls[10–13] Compared with normal-sighted persons, individuals with visual impairment are almost twice as likely to fall and to have recurrent falls and resultant fractures.[14] In fact, several interventions designed to prevent falls include either an objective or subjective assessment of visual acuity.[15] However, an equally large number of studies have failed to show any significant association between visual acuity and falls.[5,16–20] These disparate findings indicate that further research is needed to clarify the role of visual impairment in falls.

Existing data pertinent to the relationship between visual impairment and falls have been largely confined to Caucasian populations in the United States and Australia. Data in Asia are limited.[21–23] Because of differences in lifestyle, environment, culture, and nutritional habits, it cannot be assumed that the relationship between visual impairment and falls in Western countries would be similar in Asian nations. This association should be empirically demonstrated. People of Malay ethnicity are a substantial proportion of the population of Southeast Asia. They tend to concentrate in the cities and urban areas, which can increase the risks of falling, perhaps because of living in highly populated, cluttered areas, as increasing hip fracture rates in Hong Kong and other parts of Asia have been attributed to increasing urbanization.[24]

An overwhelming majority of Malays in Singapore are Muslim and adhere to Islamic principles, lifestyle, diet, and culture. There are also variations in rates of systemic and eye diseases and utilization of eye care services between Chinese, Indians, and Malays.[25–29] However, limited data are available on the relationship between eye disease and the rate of falls in Malays living in Singapore. Even less is known of what other vision-related factors are associated with the high risk of falls. If factors such as the severity of vision loss and unilateral or bilateral visual impairment are shown to be independently associated with falls, then vision-related interventions that are likely to reduce the incidence of falls in this population must be implemented. In addition, there is potential for the data on falls to be generalized to other urban Asian populations.

The Singapore Malay Eye Study was undertaken to determine the prevalence and impact of visual impairment and major eye diseases in urban Asian populations. In this article, we report the association between visual impairment and the main causes of vision loss, and falls. This information is fundamental in understanding the impact of visual impairment and in establishing prevention and rehabilitation programs for visually impaired persons who are at higher risk of falling.

## Methods

### Study Population

The Singapore Malay Eye Study is a population-based cross-sectional study of 3280 Malay subjects residing in Singapore and the study

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procedures have been described elsewhere.[8] Briefly, an age-stratified random sampling procedure was used to select Malay people aged 40 to 80 years living in the South-Western part of Singapore.[8] Of an initial 5600 names, 4168 (74.4%) were deemed eligible participants based on prespecified criteria.[8] Between August 2004 and June 2006, 3280 Malays were examined in the clinic, giving an overall response rate of 78.7%. The remaining 888 (21.3%) were classified as nonparticipants. Nonparticipants were older but did not differ by gender or possession of telephone in their homes (data not shown). Sociodemographic and medical data were recorded with a standardized questionnaire that has been described elsewhere.[8] The study was conducted in accordance with the Declaration of Helsinki. Ethics approval was obtained from the Singapore Eye Research Institute Institutional Review Board.

## Vision Assessment

At the study center, participants underwent an extensive and standardized examination that included visual acuity testing and a detailed clinical slit lamp examination. For each eye, the participant's presenting visual acuity (PVA), was ascertained with participants wearing their habitual optical corrections (spectacles or contact lenses). In the present study, only PVA data were used, as we believe that this acuity gives a more accurate picture of the role of visual acuity in study participants' performance of the activities of daily living.[30]

Visual acuity was measured using a logarithm of the minimum angle of resolution (logMAR) vision chart (Lighthouse International, New York, NY) at 4 m distance. If no numbers were read at 4 m, the participant was moved to 3, 2, or 1 m, consecutively. If no numbers were identified on the chart, visual acuity was assessed as counting fingers, hand movements, perception of light, or no perception of light. Primary causes of visual impairment were diagnosed by study ophthalmologists after detailed slit lamp examination before and after pupil dilation.

## Definition of Visual Impairment

We defined mild or moderate visual impairment as PVA worse than 20/40 but better than 20/200 in the better eye ($0.3 < \text{logMAR} < 1.0$) and severe impairment with VA ≤20/200 in the better eye ($\text{logMAR} \geq 1.0$).[31] Participants with no visual impairment were categorized as normal (≤0.3 logMAR). For analysis, we defined the preceding visual acuity categories using PVA in the better (bilateral visual impairment) and worse eye (unilateral). We also defined the following exclusive six groups: (1) severe visual impairment in both eyes; (2) severe visual impairment in one eye and mild or moderate visual impairment in the other eye; (3) mild or moderate visual impairment in both eyes; (4) severe visual impairment in one eye and normal vision in the other eye; (5) mild or moderate visual impairment in one eye and normal vision in the other eye; and (6) normal vision in both eyes. Group 6 was the reference level.

## Main Outcome Measure: Falls

The following question was asked to obtain data pertinent to falls: "Did you have any fall in the past 12 months whereby you landed on the ground or floor?" A participant was classified as a "faller" if a fall had happened in the past 12 months. Otherwise, he or she was classified as a "nonfaller."

## Questionnaires

Details about height, weight, body mass index (BMI; weight (kg)/[height (m)]$^2$), systolic and diastolic blood pressures, axial length, anterior chamber depth, and corneal curvature in horizontal and vertical meridians were obtained. Nonfasting serum glucose, lipids (total cholesterol, HDL-cholesterol, direct LDL cholesterol), glycosylated hemoglobin ($HbA1_c$), and creatinine were measured from venous blood samples collected from participants. Other collected data were country of birth, marital status, education, occupation, and current housing status. Information about participants' lifestyle (including cigarette smoking), eye symptoms, use of glasses, systemic medical and surgical history, bone fracture history, current medications, and family history of eye disease was also recorded. Female participants were asked questions on gender-related health. The modified EuroQoL Health Questionnaire (EQ-5D)[32] was used to assess overall quality of life consisting of five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), each of which can have one of three responses (no problems, some or moderate problems, or extreme problems). The EQ-5D utility index scores usually range between 0.0 (death) and 1.0 (perfect health).

## Statistical Analysis

Data were analyzed with commercial software (SPSS, ver. 14.0.1; SPSS Science, Chicago, IL). $P < 0.05$ indicated statistical significance. Descriptive statistical analyses were performed, and binary logistic regression models were used to assess associations with each potential vision risk factor (PVA in the better and worse eyes, presenting unilateral and bilateral visual acuity and main cause of vision loss in the right and left eyes) with falls in the last 12 months, while controlling for the effects of other risk factors related to falls. Evidence of multicollinearity was assessed using the collinearity diagnostics in SPSS. Finally, the Hosmer-Lemeshow goodness-of-fit test was used to assess the overall fit of the model, in which $P > 0.05$ indicates no evidence of misfit.

# Results

The sociodemographic and personal characteristics of all 3280 participants and the fallers and nonfallers are shown in Table 1. Overall, the mean age was 58.7 years, and there were more female (52%) than male participants. Almost one third reported a history of hypertension (31.5%), and one fifth (20.1%) gave a history of diabetes. A majority (74.1%) was married, never smoked (61.3%), and lived in three- to four-bedroom apartments (68.7%).

Overall, more than one third (36.4% and 36.0% of right and left eyes, respectively) of the participants were considered mildly or moderately visually impaired ($0.3 < \text{logMAR} < 1.0$) or blind ($\text{logMAR} \geq 1.0$) in either eye, based on PVA before refraction (Table 2). The mean PVAs in the better and worse eyes were 0.21 ± 0.23 and 0.32 ± 0.27 logMAR, respectively. Of the participants, 2421 (73.8%) and 1755 (53.5%) were considered to have normal PVA (≤0.3 logMAR) in the better and worse eyes, respectively, whereas 645 (19.7%) had mild or moderate visual impairment in both eyes, and 58 (1.8%) had severe visual impairment in both eyes. The main cause of vision loss was undercorrected refractive error, followed by cataract.

Of the 3280 participants, 3266 (99.6%) provided information about falls. Of these, 14.7% ($n = 480$) reported having fallen in the past 12 months. The nonvision characteristics associated with an increased likelihood of falling, after adjustment for age and gender are shown in Table 1. Age, gender, BMI, self-rated health (EQ-5D utility score), and self-reported histories of angina, heart attack, stroke, hypertension, and diabetes were significantly associated with having fallen in the last 12 months.

In multivariate models after adjustment for gender, age, body mass index, history of angina, heart attack, stroke, hypertension, diabetes, and self rated health (EQ-5D utility index), the causes of vision loss for the right, left, or both eyes were similar. Unilateral severe visual impairment, defined using $\text{logMAR} \geq 1.0$ in the worse eye, significantly increased the likelihood (60%; $P < 0.05$; Table 3). Severe visual impairment in one eye and mild or moderate visual impairment in the other doubled the likelihood of falling. Having cataract, glaucoma, or other causes of visual impairment was associated with falls. However, when PVA was included in the model, only glau-

**Table 1.** Characteristics of All Participants, Fallers, and Nonfallers*

| | | All ($n$ = 3266) | Fallers ($n$ = 480) | Nonfallers ($n$ = 2786) |
|---|---|---|---|---|
| Weight (kg) | Mean ± SD | 66.1 ± 13.7 | 66.1 ± 13.8 | 65.4 ± 13.4 |
| Gender | Male-number (%) | 1568 (48) | 158 (32.9) | 1410 (50.6)† |
| BMI (kg/m$^2$) | Mean ± SD | 26.4 ± 5.1 | 27.06 ± 5.3 | 26.4 ± 5.1‡ |
| Age (y) | Mean ± SD | 58.7 ± 11.0 | 61.6 ± 11.4 | 58.2 ± 10.9§ |
| Cholesterol (mmol/L) | Total mean ± SD | 5.6 ± 1.2 | 5.6 ± 1.2 | 5.6 ± 1.3 |
| | LDL | 3.5 ± 1.0 | 3.4 ± 1.0 | 3.5 ± 0.9 |
| | HDL | 1.4 ± 0.3 | 1.3 ± 0.3 | 1.4 ± 0.3 |
| Angina, $n$ (%)‖ | Yes | 116 (3.6) | 28 (5.8) | 88 (3.2)‡ |
| Heart attack, $n$ (%)‖ | Yes | 212 (6.5) | 50 (10.4) | 162 (5.8)‡ |
| Stroke, $n$ (%)‖ | Yes | 81 (2.5) | 25 (5.2) | 56 (2.0)‡ |
| Thyroid, $n$ (%)‖ | Yes | 84 (2.6) | 12 (2.5) | 72 (2.6) |
| Hypertension, $n$ (%)‖ | Yes | 1254 (38.8) | 242 (50.8) | 1012 (36.7)‡ |
| Diabetes, $n$ (%)‖ | Yes | 657 (20.3) | 134 (28.2) | 523 (18.9)‡ |
| Alcohol consumption | Yes | 53 (1.6) | 10 (2.1) | 43 (1.5) |
| Medication (≥1) | Yes | 209 (6.4) | 50 (10.4) | 159 (5.7) |
| Smoking Status | Never smoked | 2009 (61.6) | 335 (69.8) | 1674 (60.1) |
| | Current smokers | 659 (20.2) | 66 (45.5) | 593 (53.6) |
| | Past smokers | 592 (47.3) | 79 (54.5) | 513 (46.4) |
| Living arrangements | 1–2-room flat | 501 (15.4) | 107 (22.3) | 394 (14.2) |
| | 3–4-room flat | 2246 (68.9) | 301 (62.8) | 1945 (69.9) |
| | ≥5-room flat | 472 (14.5) | 61 (12.7) | 411 (14.8) |
| | Private housing | 43 (1.3) | 10 (2.1) | 33 (1.2) |
| Ethnicity | Malay | 2138 (65.5) | 317 (66.2) | 1821 (65.4) |
| | Boyanese | 400 (12.3) | 43 (9.0) | 357 (12.8) |
| | Javanese | 654 (20.1) | 105 (21.9) | 549 (83.9) |
| | Others | 72 (2.2) | 14 (19.4) | 58 (19.7) |
| Income (S$) | <1000 | 1829 (56.4) | 304 (65.3) | 1525 (55.1) |
| | 1000 to <2000 | 655 (20.2) | 58 (12.1) | 597 (21.6) |
| | 2,000 to <3000 | 236 (7.3) | 23 (4.8) | 213 (7.7) |
| | >3000 | 111 (3.4) | 10 (2.1) | 101 (3.7) |
| | Retired | 414 (12.8) | 84 (17.5) | 330 (11.9) |
| Marital Status | Never married | 138 (4.2) | 16 (3.3) | 122 (4.4) |
| | Married | 2426 (74.5) | 311 (64.9) | 2115 (76.2) |
| | Separated/Divorced | 178 (5.5) | 29 (6.1) | 149 (5.4) |
| | Widowed | 514 (15.8) | 123 (25.7) | 391 (14.1) |
| EQ-5D utility score | Mean ± SD | 0.83 ± 0.2¶ | 0.73 ± 0.2 | 0.84 ± 1.7‡ |

* $n$ = 3266. Fourteen participants did not provide data on falls.
† Statistically significant difference after controlling for age ($P < 0.05$).
‡ Statistically significant difference after controlling for age and gender ($P < 0.05$).
§ Statistically significant difference after controlling for gender ($P < 0.05$).
‖ Self reported history.
¶ A score of 1.0 indicates perfect health.

coma was found to be independently associated with falls. Having glaucoma increased the risk of falling by more than fourfold (OR = 4.2; 95% CI 1.2–12.3). Presenting mild and moderate visual impairment in the better eye was not significantly associated with falls, although the odds ratios were in the same risk direction.

## Discussion

There are limited data about the role of vision-specific characteristics of falls in Asian populations. In this population-based study from Singapore, we found further evidence of the relationship between visual impairment and falls. Unilateral severe visual impairment, mainly due to eye disease rather than refractive errors, was significantly associated with an increased likelihood of falling. Having glaucoma increased the risk of falling by more than fourfold, although our finding must be treated with caution, as there were few participants in the study who had diagnosed glaucoma. Overall, our findings substantiate those in some previous studies of vision and falls and confirm that severe visual impairment, but not mild or moderate visual impairment, is independently related to falls.

Although several large prospective or retrospective studies have found worse visual acuity to be associated with an increased risk of falling,[11,13,30,33] other studies have not replicated these findings,[16,17,34] and to our knowledge only one study examined an Asian population.[22] The reasons underpinning these conflicting findings are unclear, although it is worth noting that in studies that reported an independent association between visual acuity and falls, the researchers used "multiple falls" as the study outcome, whereas we used "one fall" during the past 12 months as the main outcome. The Beaver Dam Eye Study reported a 2.6-fold higher risk of multiple falls over 12 months, for habitual visual acuity levels 0.09 logMAR (6/7.5 Snellen) or worse.[11] Similarly, the Blue Mountains Eye Study found that multiple falls were approximately twice as likely, if habitual visual acuity was worse than 0.18 logMAR (6/9).[30] On the other hand, Nevitt et al.[17] did not find a significant association between visual impairment and falls, although the they reported that the risk factors for having a single fall were few and relatively weak, but multiple falls were more predictable. Similarly, Lord and Dayhew[16] found that being in the worst quartile for measures of visual acuity, contrast sensitivity, depth perception, and visual field angle significantly increased the risks of having multiple falls but not a single fall. It is possible that "multiple falls" provides a more robust dependent variable than "any falls," when establishing vision-specific risk factors for falls. This hypothesis should be

**TABLE 2.** The Vision-Specific Characteristics of the Participants

| Characteristic | Right Eye | Left Eye |
|---|---|---|
| PVA (logMAR) | | |
| Mean ± SD | 0.26 ± 0.25 | 0.26 ± 0.26 |
| Normal vision, *n* (%) | 2081 (63.6) | 2095 (64.0) |
| Mild or moderate visual impairment, *n* (%) | 1026 (31.4) | 1021 (31.2) |
| Severe visual impairment, *n* (%) | 164 (5.0) | 155 (4.7) |
| Main cause of vision loss, *n* (%) | | |
| Cataract | 450 (13.7) | 458 (14.0) |
| UCRE | 671 (20.5) | 643 (19.6) |
| Glaucoma | 21 (0.6) | 16 (0.5) |
| Diabetic Retinopathy | 32 (1.0) | 32 (1.0) |
| ARM | 22 (0.7 | 20 (0.6) |
| Other | 57 (1.7) | 61 (1.9) |
| **Characteristic** | **Better Eye** | **Worse Eye** |
| PVA (logMAR) | | |
| Mean ± SD | 0.21 ± 0.23 | 0.32 ± 0.27 |
| Normal vision, *n* (%) | 2421 (73.8) | 1755 (53.5) |
| Mild or moderate visual impairment, *n* (%) | 790 (24.1) | 1257 (38.3) |
| Severe visual impairment, *n* (%) | 58 (1.8) | 261 (8.0) |
| **Characteristic** | ***n*** | **%** |
| Presenting bilateral/unilateral categories of vision impairment (*n*) | | |
| Normal vision in both eyes | 1753 | 53.6 |
| Severe visual impairment in both eyes | 58 | 1.8 |
| Severe visual impairment in one eye, and mild or moderate visual impairment in the other | 145 | 4.4 |
| Mild or moderate visual impairment in both eyes | 645 | 19.7 |
| Severe visual impairment in one eye, normal vision in the other | 56 | 1.7 |
| Mild or moderate visual impairment in one eye, normal vision in the other | 612 | 18.7 |

Vision data are not available for 9 participants in the right eye and 9 participants in the left eye. Vision data are not available for 11 participants in the better eye and 7 participants in the worse eye. PVA, presenting visual acuity; UCRE, under corrected refractive error; ARM, age-related maculopathy; normal vision ≤0.3 logMAR; mild or moderate visual impairment, 0.3 < logMAR < 1.0; severe visual impairment (blindness), logMAR ≥ 1.0.

**TABLE 3.** The Odds Ratios Showing Associations between Having a Fall in the Past 12 Months and Vision-Specific Characteristics

| Characteristics | *n* (%) | OR (95% CI)* |
|---|---|---|
| Presenting visual acuity-better eye | | |
| Normal vision | 2416 (74.2) | 1.0 |
| Mild or moderate visual impairment | 784 (24.1) | 1.3 (1.0–1.6) |
| Severe visual impairment | 57 (1.8) | 1.6 (0.8–3.0) |
| Presenting visual acuity-worse eye | | |
| Normal vision | 1751 (53.7) | 1.0 |
| Mild or moderate visual impairment | 1251 (38.4) | 1.1 (0.9–1.4) |
| Severe visual impairment | 259 (7.9) | 1.6 (1.1–2.3) |
| Main cause of vision loss-right eye | | |
| None | 2019 (61.8) | 1.0 |
| Cataract | 447 (13.7) | 1.6 (0.9–2.3) |
| UCRE | 670 (20.5) | 1.3 (0.7–2.2) |
| Glaucoma | 20 (0.6) | 4.2 (1.2–12.3) |
| Diabetic Retinopathy | 32 (1.0) | 1.7 (0.7–4.3) |
| ARM | 22 (0.7) | 0.3 (0.0–2.6) |
| Other | 56 (1.7) | 1.8 (0.8–4.2) |
| Presenting bilateral/unilateral categories of vision impairment | | |
| Normal vision in both eyes | 1753 (53.6) | 1.0 |
| Severe visual impairment in both eyes | 58 (1.8) | 1.5 (0.7–2.8) |
| Severe visual impairment in one eye and mild or moderate visual impairment in the other | 145 (4.4) | 2.1 (1.4–3.1) |
| Mild or moderate visual impairment in both eyes | 645 (19.7) | 1.2 (0.9–1.5) |
| Severe visual impairment in one eye, normal vision in the other | 56 (1.7) | 0.7 (0.3–1.6) |
| Mild or moderate visual impairment in one eye, normal vision in the other | 612 (18.7) | 1.1 (0.8–1.4) |

* Adjusted for gender, age, BMI, history of angina, heart attack, stroke, hypertension, diabetes, and self-rated health (EQ-5D utility index) and visual acuity (for main cause of vision loss only). Normal-vision, ≤0.3 logMAR; mild or moderate visual impairment, 0.3 < logMAR < 1.0; severe visual impairment (blindness), logMAR ≥ 1.0.

investigated in future surveys, as the present study did not collect these data.

Although visual field data were not collected, the presence of glaucoma increased the risk of falling by more than fourfold after adjustment for visual acuity. Our finding indicates that glaucoma as an eye disease entity, rather than the visual acuity loss caused by glaucoma, is associated with falls. A diagnosis of glaucoma has been identified as a risk factor for falls in both population-based and hospital-based studies of older persons.[35,36] People with glaucoma can have compromised visual field which is associated with poor postural stability and a greater capacity to bump into objects, which could also lead to a greater tendency to fall.[37,38] Our finding that participants with glaucoma tend to have a greater risk of falls is therefore not surprising. There is no consensus, however, on the association between glaucoma and falls, as other studies have found no association between self-reported or diagnosed glaucoma and falls.[30,33] It is difficult to explain the discrepancy between the findings in these different studies, but they may be related to study design, sample size, and how glaucoma was assessed. In a recent prospective population-based study, however, visual field was found to be the only independent predictor of falls that supports our findings of strong associations between glaucoma and falls.[34] These associations were assessed after adjustment for visual acuity level or visual field defect and probably operate via poor visual function associated with these ocular conditions.

The prevalence of falls in our study was 14.7% and is similar to the rate reported in another population-based eye surveys, the Blue Mountains Eye Study (16.1%),[30] a prospective longitudinal study in Chinese elderly (19.3%),[22] and cross-sectional studies in Hong Kong (18%)[21] and Thailand (19.8%).[23] It is considerably lower, however, than the rate reported by the Salisbury Eye Evaluation (SEE) Project in which 29% of their participants reported having had at least one fall.[34] Similar or even higher prevalence rates (28%–35%) have been reported in community-dwelling elderly individuals.[3–6,19] The participants in the SEE project, however, were considerably older than those in our study (75 years vs. 58 years).

The implication of the research evidence is that prevention, detection, and treatment of vision-related factors can reduce the risk of falls in older people. Multifactorial trials that have included vision-related intervention components have shown to reduce the risks of falls significantly,[39,40] and the results in these trials indicate that intervention to improve visual function in older people, particularly in combination with other forms of intervention, can play an important role in the prevention of falls.[41] Similarly, two studies have shown that cataract surgery can prevent falls[42,43] and suggest that visual impairment related to eye disease is critically important to reducing falls rates and hip fractures.

A limitation of this study is the self-reported nature of the main outcome measure, which may introduce recall bias, especially if people with poor vision recall falls differently than those who are not visually impaired. Another potential weakness is that we were not able to adjust for all variables previously shown to predict falls, such as visual field, depth perception, contrast sensitivity, gait, and balance,[5,17,20] as these data were not collected. Finally, considering that the falls data in our study were collected retrospectively, it is possible that the "true" frequency of falls is than that reported, as it has been shown that more than 30% of the elderly can fail to recall falls.[44]

In summary, our findings from this large Asian population document independent relationships between unilateral severe visual impairment, glaucoma, and falls in the previous 12 months. These findings provide further evidence on the impact of visual impairment among older persons. Thus, strategies should be developed to provide visually impaired people with a fall-prevention environment, to reduce this impact of visual impairment and improve the quality of life.[7]

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