Glaucoma in a Rural Population of Southern India

The Aravind Comprehensive Eye Survey

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Purpose: To determine the prevalence of glaucoma and risk factors for primary open-angle glaucoma in a rural population of southern India.

Design: A population-based cross-sectional study.

Participants: A total of 5150 subjects aged 40 years and older from 50 clusters representative of three southern districts of Tamil Nadu in southern India.

Methods: All participants had a comprehensive eye examination at the base hospital, including visual acuity using logarithm of the minimum angle of resolution illiterate E charts and refraction, slit-lamp biomicroscopy, gonioscopy, applanation tonometry, dilated fundus examinations, and automated central 24-2 full-threshold perimetry.

Main Outcome Measures: Definite primary open-angle glaucoma (POAG) was defined as angles open on gonioscopy and glaucomatous optic disc changes with matching visual field defects, whereas ocular hypertension was defined as intraocular pressure (IOP) greater than 21 mmHg without glaucomatous optic disc damage and visual field defects in the presence of an open angle. Manifest primary angle-closure glaucoma (PACG) was defined as glaucomatous optic disc damage or glaucomatous visual field defects with the anterior chamber angle partly or totally closed, appositional angle closure or synechiae in the angle, and absence of signs of secondary angle closure. Secondary glaucoma was defined as glaucomatous optic nerve damage and/or visual field abnormalities suggestive of glaucoma with ocular disorders that contribute to a secondary elevation in IOP.

Results: The prevalence (95% confidence interval) of any glaucoma was 2.6% (2.2, 3.0), of POAG it was 1.7% (1.3, 2.1), and if PACG it was 0.5% (0.3, 0.7), and secondary glaucoma excluding pseudoexfoliation was 0.3% (0.2, 0.5). On multivariate analysis, increasing age, male gender, myopia greater than 1 diopter, and pseudoexfoliation were significantly associated with POAG. After best correction, 18 persons (20.9%) with POAG were blind in either eye because of glaucoma, including 6 who were bilaterally blind and an additional 12 persons with unilateral blindness because of glaucomatous optic neuropathy in that eye. Of those identified with POAG, 93.0% had not been previously diagnosed with POAG.

Conclusions: The prevalence of glaucoma in this population is not lower than that reported for white populations elsewhere. A large proportion of those with POAG had not been previously diagnosed. One fifth of those with POAG had blindness in one or both eyes from glaucoma. Early detection of glaucoma in this population will reduce the burden of blindness in India. Ophthalmology 2003;110:1484–1490 © 2003 by the American Academy of Ophthalmology.

Glaucoma is a leading cause of blindness in various populations across the world. The prevalence of glaucoma varies by region and race, with open-angle glaucoma more frequent among persons of West African descent and angle-closure glaucoma more frequent among East Asian and Eskimo populations. In addition to variations in the prevalence of these disorders, there is significant variation in visual loss associated with glaucoma by ethnic group.

India is the second most populated country and has more than 1 billion people. The impact of visual disability and blindness from glaucoma is most likely costly. Despite its

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public health significance, there have been limited data available on the prevalence of glaucoma and possible risk factors for glaucoma in India. Previous population-based studies from India\textsuperscript{12–14} have reported the prevalence of glaucoma in urban populations. There has been no report on the prevalence of glaucoma in rural populations from India. In addition, in these prior studies, perimetry was limited to those who fulfilled certain conditions, such as elevated intraocular pressure (IOP) or optic disc cupping. This approach offers the potential to miss those who did not meet these criteria but had glaucomatous optic nerve damage.\textsuperscript{5}

This is the first population-based study from India to attempt threshold perimetric evaluations and dilated fundus examinations on all participants. In this article, we report on the prevalence of glaucoma in a rural population of southern India and evaluate possible associated risk factors for primary open-angle glaucoma (POAG).

**Subjects and Methods**

The Aravind Comprehensive Eye Survey is a population-based prevalence study of glaucoma and other visually impairing ocular disorders conducted among a rural population in the state of Tamil Nadu in southern India. This article reports results on subjects aged 40 years or older, a subset of the entire Aravind Comprehensive Eye Survey population. The study design and methods are described elsewhere.\textsuperscript{15} Details of the methods pertaining to this particular study are described later in the article. We used two-stage cluster sampling to identify the study population. Trained social workers performed enumeration after a door-to-door survey; demographic details were recorded for all enumerated subjects. Subjects aged 40 years and older were invited to the base hospital for comprehensive ocular examinations.

**Ocular Examinations**

We measured presenting distance and near visual acuity and visual acuity with best correction after refraction using illiterate E logMAR charts. Blindness was defined as a best-corrected vision $<3/60$ in the better eye. For all subjects 40 years or older, all examinations consisted of the following: subjective retinoscopic refraction, measurements of presenting and best-corrected visual acuity, automated full-threshold visual fields for subjects with best-corrected visual acuity better than 6/60 using the C-24-2 full-threshold program on the Humphrey 650 Visual Field Analyzer (Dublin, CA), evaluation of pupillary response, external and anterior segment examination at the slit-lamp biomicroscope, measurement of IOP with a Goldmann applanation tonometer (three independent readings in each eye), and gonioscopy using a Goldmann lens. After pupillary dilation, grading of the lens was conducted using the Lens Opacities Classification System III;\textsuperscript{17} stereoscopic examination of the vitreous, retina, and optic nerve was done at the slit lamp with a 78-D lens and with an indirect ophthalmoscope using a 20-D lens.

Visual field examination was deferred for participants who either refused or had visual acuity less than 6/30 in the eye to be tested. If the visual field was determined to be abnormal and/or unreliable, it was repeated on a subsequent day or on the same day after the subject had adequate rest. Criteria used to determine abnormality included abnormal glaucoma hemifield test or corrected pattern standard deviation $P < 0.05$. Criteria used to determine unreliability of the fields included false-positive results $\geq50\%$, false-negative results $\geq33\%$, and fixation losses $\geq50\%$.\textsuperscript{16} IOP was measured using Goldman applanation tonometry at the slit lamp with the patient under local anesthesia; three consecutive measurements were taken and recorded, and the median measurement was considered as the IOP for analysis. Gonioscopy was attempted on all subjects using a single-mirror Goldman contact lens (Ocular Instruments Inc., Bellevue, WA), and the angle was graded using the Shaffer system of classification. The clock hours for each grade were also recorded. Angles were considered open if more than 10 clock hours were clearly visible up to the scleral spur in each eye. All participants with open angles determined on gonioscopy had their eyes dilated using tropicamide, 1%, and/or phenylephrine, 10%. Participants who had dilatation deferred because of occludable/narrow angles had dilated examinations performed after laser iridotomy either on the same day or on a subsequent day.

Before dilatation, we looked for pseudoexfoliation (PXF) deposits on the corneal endothelium, iris, and iris margins using detailed high-magnification slit-lamp assessment. We also looked for changes in the angle, including increased pigmentation, PXF deposition, and PXF material within the angle during gonioscopy. After dilatation, the anterior lens surface was examined from left to right using a narrow slit-lamp beam under full illumination and high magnification. Early signs of PXF were looked for, including pregranular radial lines and established granular deposits. PXF was diagnosed by the presence of typical white deposits on the iris and/or anterior lens surface; additional sites where we found PXF included the cornea, anterior vitreous face, posterior capsule, and even intracapsular lenses.

Lenses were graded at the slit lamp using the Lens Opacities Classification System III.\textsuperscript{17} Posterior segment assessments, including optic disc were performed after dilatation using both a 78-D fundus lens at the slit lamp and indirect ophthalmoscopy using a 20-D lens. Vertical and horizontal cup-to-disc ratios were measured and recorded; asymmetry of discs, notching, bayoneting, disc hemorrhages, nerve fiber layer defects, peripapillary atrophy, tilted discs, and atrophy of discs were looked for and recorded. The width and location of the thinnest neuroretinal rim was also recorded in clock hours. A standard set of photographs of discs ranging from 0.0 to 1.0 was used to grade the disc. The study ophthalmologists were standardized to each other and to a senior ophthalmologist, considered the “gold standard” before the actual study. Such standardization was repeated during the study.

**Assessment of Glaucoma**

The definition of glaucoma used in this study required evidence of glaucomatous optic nerve damage and did not rely on IOPs. Such evidence was demonstrated by the presence of one or both of the following: glaucomatous changes in the appearance of the optic nerve head or nerve fiber bundle pattern perimetric defects typical of glaucomatous damage. To operationalize this criterion, subjects with a vertical cup-to-disc ratio $>0.8$ or a narrowed neuroretinal rim width $<0.2$ (including classic notching) or asymmetry $>0.2$ between eyes coupled with a visual field defect in the matching location were considered cases of glaucomatous optic nerve damage. In individuals in whom visual fields were not available because of poor visual acuity or poor reliability, the presence of significant optic disc excavation compatible with glaucoma, or end-stage glaucoma with severe central vision loss, or total optic disc cupping was sufficient for diagnosing glaucomatous optic nerve damage. IOP was considered a risk factor and not used as a diagnostic criterion for open-angle glaucoma. Subjects with symmetric, large optic cups and eyes with IOP greater than 21 mmHg, but without definite evidence of glaucomatous optic nerve damage,
were characterized as glaucoma suspects and advised to seek periodic ophthalmologic examination.

The definition of glaucomatous optic nerve damage described previously is conservative, because it does not allow for visual field loss without significant evidence of changes in the optic nerve head or large disc cupping with elevated IOP without visual field loss, or markedly elevated IOP that could cause optic nerve damage. To be sure that individuals with mildly atypical findings or inconsistencies or missing data were not overlooked, all individuals with potentially abnormal visual fields were re-reviewed by a glaucoma specialist and reexamined. Abnormal visual fields were classified as those typically compatible with a diagnosis of glaucoma (abnormal or borderline on the glaucoma hemifield test) or those that were abnormal and incompatible with glaucoma. Available visual fields of an individual were compared with one another and with the appearance of the optic disc for compatibility. None of the re-reviewed subjects met the definition of glaucomatous optic nerve damage—a vertical cup-to-disc ratio >0.8, a narrowest neuroretinal rim width <0.2 (including classic notching), or asymmetry >0.2 between eyes.

The following definitions were used to classify persons into specific diagnostic categories:

Ocular hypertension. Intraocular pressure >21 mmHg without evidence of optic nerve damage or visual field abnormalities characteristic of glaucoma; open and normal-appearing anterior chamber angle by gonioscopy.

POAG. Anterior chamber angles open and normal appearing by gonioscopy, typical features of glaucomatous optic disc as defined earlier, and visual field defects corresponding to the optic disc changes.

Primary angle-closure glaucoma. At least two of the following criteria: glaucomatous optic disc damage or glaucomatous visual field defects in combination with anterior chamber angle partly or totally closed, appositional angle closure or synchia in angle, absence of signs of secondary angle closure (e.g., uveitis, intumescence, or dislocated lens; microspherophakia; evidence of neovascularization in the angle; or congenital angle anomalies).

Secondary glaucoma. Glaucomatous optic nerve damage and/or visual field abnormalities suggestive of glaucoma coupled with ocular disorders that contribute to a secondary elevation in IOP, such as neovascularization, injury, hypermetropia or dislocated lenses, and uveitis.

Absolute glaucoma. End-stage glaucoma without adequate evidence regarding the primary insult or cause contributing to glaucomatous optic nerve damage.

Other Factors

We defined systemic hypertension as either a measured systolic blood pressure ≥160 mmHg and/or a diastolic blood pressure ≥90 mmHg or current use of systemic antihypertensive medications. Diabetes was defined as a measured postprandial blood sugar of ≥180 mg/dl or current use of antidiabetic medications. Refractive errors were classified as emmetropia, myopia, and hyperopia on the basis of spherical equivalents. Emmetropia was defined as spherical equivalents ranging from −0.5 to +0.5 D. Myopia was defined as spherical equivalent worse than −0.5 D in either phakic eye. Hyperopia was defined as spherical equivalent greater than +0.5 D in either phakic eye. Cataract-operated eyes were not included in this classification.

Informed Consent

Three levels of informed consent were used in this study: community, household, and individual. Meetings were held with community leaders and all health-related personnel in the area to explain the purpose of the study. Once approval was obtained at these meetings, the study was fully explained to all adults in the household to address any concerns and to secure consent for the household to participate. Before both screening and definitive examinations, the study was explained in detail to all potential participants, the consent statement was read to each individual, and their voluntary consent was solicited. We ensured that all subjects thoroughly understood the informed consent. We did not obtain thumbprints, because this was considered problematic as many villages have been coerced into giving away property by giving thumbprints to documents that they could not read. All informed consent was verbally obtained, because a significant proportion of this population is illiterate. The study was approved, and annually reapproved, by the Committee on Human Research at the Johns Hopkins Bloomberg School of Public Health and by the Ethical Review Committee of the Aravind Eye and Children’s Hospitals.

Statistical Analysis

Statistical analysis was performed using Stata version 7.0 software. Univariate and multivariate analyses were used to look for associations with open-angle glaucoma. Odds ratios (OR) and 95% confidence intervals (95% CI) are presented. Confidence intervals of the prevalence estimates have been calculated using a Poisson approximation of the binomial distribution. P values <0.05 have been taken to indicate statistical significance.

Results

Five thousand one hundred fifty of the eligible 5539 persons aged 40 years or more were examined, a response rate of 93.0%. The median age of those examined was 51.0 years (range, 40–90 years), and 54.5% were females.

The prevalence of glaucoma of any type was 2.6% (95% CI, 2.2, 3.0). The prevalence of POAG was 1.2% (95% CI, 0.9, 1.5). In decreasing prevalence were primary angle-closure glaucoma (prevalence, 0.5% [95% CI, 0.3, 0.7], PXF (prevalence, 0.4; 95% CI, 0.3, 0.6), secondary glaucoma from other causes excluding pseudoexfoliation (prevalence, 0.3%; 95% CI, 0.2, 0.5), and absolute glaucoma (prevalence, 0.06%; 95% CI, 0.0, 0.1). The age-adjusted (on the basis of population estimates for India for the year 2000 from the US Census Bureau, International Database, October 2002) prevalence of POAG among subjects 40 years and older was 1.2% (95% CI, 0.9, 1.5).

The median age of those with any glaucoma was 60.0 years (range, 40–85 years; mean, 60.8 years). Visual fields using the Humphrey central 24-2 full-threshold testing were performed on 4455 (86.5%) of all participants; visual field testing could not be done for the remaining 13.5% primarily because of poor visual acuity and media opacities. Of the 64 persons diagnosed with POAG, 45 (70.3%) underwent visual field testing at least once. Visual fields could not be performed on 19 (29.7%) of those diagnosed with POAG; 15 of the 19 subjects had visual acuity ≤6/60, the 4 remaining subjects had a visual acuity of 6/48. Diagnosis of POAG in such subjects was primarily based on optic disc findings alone.

After best correction with refraction, 19 persons with POAG were visually impaired, including a person who was blind (Table 2). An additional 12 persons had unilateral blindness caused by glaucomatous optic neuropathy in that eye, thus 13 (20.3%) per-
sons with POAG were blind in one or both eyes as a result of POAG.

The prevalence for POAG with increasing age is shown in Table 1. The odds for POAG increased with advancing age after adjusting for gender (reference category, 40–49 years, OR, 4.3; 95% CI, 1.8, 10.0; 60–69 years, OR, 4.9; 95% CI, 2.1, 11.3; ≥70 years, OR, 6.6; 95% CI, 2.6, 16.9). Males were more likely to have POAG in our study after adjusting for age (OR, 2.2; 95% CI, 1.3, 3.8).

Of the 64 subjects diagnosed with POAG, 32 (50.0%) had seen an ophthalmologist previously; none of these 32 subjects had an ocular consultation within the year before our study. Six of these 32 subjects who had an ocular consultation had previously been diagnosed with glaucoma, 2 had undergone trabeculectomies, and 4 were taking antiglaucoma medications.

After best correction with refraction, six persons with POAG were bilaterally blind (Table 2). An additional 12 persons had unilateral blindness because of glaucomatous optic neuropathy in that eye; thus 18 persons (20.9%) with POAG were blind in one or both eyes as a result of POAG.

We did not find a significant difference in IOP across ages. The mean IOP (standard deviation [SD]) for subjects without POAG aged 40 to 49 years was 14.7 (3.3); 50 to 59 years, 14.5 (3.7); 60 to 69 years, 14.1 (3.7); and ≥70 years, 14.4 (4.0). The corresponding mean IOP (SD) for subjects with POAG was 40 to 49 years, 19.4 (4.7); 50 to 59 years, 21.8 (10.0); 60 to 69 years, 20.6 (10.4); and ≥70 years, 21.1 (7.0). The mean IOP was higher among those with POAG than subjects without glaucoma for all age groups (P < 0.01). Forty-five (52.3%) of the 86 subjects with POAG had IOP > 21 mmHg. Figure 1 shows the prevalence of POAG with increasing IOP. The median vertical cup-to-disc ratio was 0.3 ± 0.16 among those without glaucoma and 0.80 ± 0.11 among those with glaucoma. Of the 576 eyes with vertical cup-to-disc ratios greater than 0.6, 85.1% did not have glaucoma.

Ocular hypertension was present in 57 subjects (1.1%; 95% CI, 0.84,1.4). The median age of those with ocular hypertension was 52.0 years (range, 40–75 years), and there was no significant gender difference in prevalence (P = 0.59). The median IOP was 23 mmHg, with a range from 22 to 58 mmHg.

Neither diabetes nor systemic hypertension was associated with POAG in our data, although the power to detect even large associations was limited (diabetes, OR, 1.1; 95% CI, 0.4, 2.9; hypertension, OR, 1.0, 95% CI, 0.5, 1.8). PXF was associated with elevated odds of POAG (OR, 5.7; 95% CI, 3.5,9.5). Myopia was present in 51 persons (59.3%) with POAG; this association was statistically significant on univariate analysis (OR, 1.9; 95% CI, 1.2, 2.9).

The strength of associations between POAG and potential risk factors was not significantly altered after multivariate analysis using logistic regression (see Table 3). Age, gender, pseudoexfoliation, and myopia continued to be associated with the presence of POAG. We did not examine the association of pulse pressure and the development of glaucoma.

Discussion

To date, limited data from India are available on the prevalence of glaucoma. Previous studies have reported the prevalence from two urban populations in southern India.12–14 The two previously reported studies differ from our study in the following ways: visual field examinations were performed only on suspicion of glaucoma and not for all participants; such suspicion was most often based on IOPs being >21 mmHg. These previous studies also did not report on risk factors for glaucoma other than IOP.

Definite POAG was considered present in 3.8% (age adjusted to US population estimates for the year 2000) of those aged 40 years and older. This is higher than that reported for white populations7–9,18–20 in North America, Europe, and Australia but still lower than that reported for populations of West African origin.5,7 The prevalence of POAG reported by us is most likely an underestimate, because we have used a strict definition (based on disc and field changes) for glaucoma. The prevalence we report is still higher than that reported for open-angle glaucoma from

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Table 1. Prevalence of Primary Open-angle Glaucoma by Age and Gender

<table>
<thead>
<tr>
<th>Age (ys)</th>
<th>Females</th>
<th></th>
<th></th>
<th>Males</th>
<th></th>
<th></th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>n (p, 95% CI)</td>
<td>N</td>
<td>n (p, 95% CI)</td>
<td>N</td>
<td>n (p, 95% CI)</td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>1280</td>
<td>2 (0.2, 0.0, 0.4)</td>
<td>786</td>
<td>5 (0.6, 0.0, 1.2)</td>
<td>2066</td>
<td>7 (0.3, 0.0, 0.6)</td>
<td></td>
</tr>
<tr>
<td>50–59</td>
<td>795</td>
<td>7 (0.9, 0.2, 1.5)</td>
<td>671</td>
<td>16 (2.4, 1.2, 3.5)</td>
<td>1466</td>
<td>23 (1.6, 0.9, 2.2)</td>
<td></td>
</tr>
<tr>
<td>60–69</td>
<td>607</td>
<td>8 (1.3, 0.4, 2.2)</td>
<td>594</td>
<td>14 (2.4, 1.1, 3.6)</td>
<td>1201</td>
<td>22 (1.8, 1.1, 2.6)</td>
<td></td>
</tr>
<tr>
<td>≥70</td>
<td>154</td>
<td>3 (1.9, 0.3, 4.1)</td>
<td>263</td>
<td>9 (3.4, 1.2, 5.6)</td>
<td>417</td>
<td>12 (2.9, 1.3, 4.5)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2836</td>
<td>28 (0.7, 0.4, 1.0)</td>
<td>2314</td>
<td>58 (1.9, 1.3, 2.5)</td>
<td>5150</td>
<td>64 (1.2, 0.9, 1.5)</td>
<td></td>
</tr>
</tbody>
</table>

CI = confidence interval; N = total subjects; n = number with POAG; p = prevalence.

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Table 2. Best-corrected Visual Acuity and Primary Open-angle Glaucoma*

<table>
<thead>
<tr>
<th>Best corrected vision</th>
<th>≥20/60</th>
<th>&lt;20/60–20/200</th>
<th>&lt;20/200–20/400</th>
<th>&lt;20/400</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No POAG</td>
<td>4169</td>
<td>579 (11.9)</td>
<td>57 (1.2)</td>
<td>48 (1.0)</td>
<td>4853</td>
</tr>
<tr>
<td>POAG</td>
<td>42</td>
<td>18 (29.5)</td>
<td>0 (0.0)</td>
<td>1 (1.6)</td>
<td>61</td>
</tr>
</tbody>
</table>

*Data presented as number of subjects (%); total does not include 235 persons without best-corrected vision available. POAG = primary open angle glaucoma.
an urban population of Vellore in southern India (0.41%; 95% CI, 0.01, 0.81) but lower than the prevalence from another urban population from southern India in Hyderabad, although the 95% CIs overlap (2.56%; 95% CI, 1.22,3.91). Again, both these other studies did not perform threshold perimetry on all participants. Because approximately half of our eyes with glaucoma had screening IOPs < 21 mmHg, these eyes would have been missed had perimetry not been performed. Another reason might be the difference in the age of the study participants; the Vellore study did not include those aged more than 60 years, whereas we found significant increasing odds for glaucoma older than the age of 60 years. Our prevalence of POAG among those aged 40 to 60 years is 0.7 (95% CI, 0.5, 1.0), similar to that found in Vellore.

Only 7% of those with POAG had been previously diagnosed, despite 45.4% of the participants with definite POAG having had prior ocular consultations for various reasons. The prevalence of subjects with POAG that presented bilaterally blind is much higher than the 7.6% seen in Baltimore but similar to the 18.5% who had at least one blind eye reported from Andhra Pradesh in India. Early detection and subsequent treatment of POAG might help to substantially reduce the burden of this blindness caused by glaucoma.

Data from our study suggest that there is no particular cutoff point for IOP beyond which glaucoma develops, although increasing IOP was a significant risk factor for

Table 3. Multivariate Analysis for Risk Factors for Primary Open-angle Glaucoma

<table>
<thead>
<tr>
<th></th>
<th>Adjusted Odds (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Yrs)</strong></td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>1.00</td>
</tr>
<tr>
<td>50–59</td>
<td>4.5 (1.6,12.2)*</td>
</tr>
<tr>
<td>60–69</td>
<td>4.0 (1.4,11.3)*</td>
</tr>
<tr>
<td>≥70</td>
<td>7.2 (2.3,22.4)*</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
</tr>
<tr>
<td>Male</td>
<td>2.6 (1.5,4.6)*</td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>1.00</td>
</tr>
<tr>
<td>Present</td>
<td>0.9 (0.3,2.9)</td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>1.00</td>
</tr>
<tr>
<td>Present</td>
<td>1.0 (0.5,2.0)</td>
</tr>
<tr>
<td><strong>No PXF</strong></td>
<td>1.00</td>
</tr>
<tr>
<td><strong>PXF</strong></td>
<td>3.4 (1.8,6.4)*</td>
</tr>
<tr>
<td><strong>Myopia</strong></td>
<td></td>
</tr>
<tr>
<td>No myopia</td>
<td>1.00</td>
</tr>
<tr>
<td>Mild myopia</td>
<td>2.9 (1.3,6.9)*</td>
</tr>
<tr>
<td>Moderate myopia</td>
<td>2.1 (1.0,4.6)</td>
</tr>
<tr>
<td>Severe myopia</td>
<td>3.9 (1.6,9.5)</td>
</tr>
</tbody>
</table>

PXF = pseudo exfoliation.
glaucoma. The continuous nature of the IOP-glaucoma relationship has been reported in both the Baltimore Eye Study\(^1\) and the Blue Mountains Eye Study.\(^2\)

The potential relationship between diabetes and POAG has been controversial. The Baltimore Eye Survey\(^2\) suggested that diabetes and POAG were not related; more recently, the Blue Mountains Eye Study\(^3\) supported the association between diabetes and POAG. We did not find any significant association between diabetes and POAG in our study. The diagnostic criteria for glaucoma used in our study was independent of IOP, similar to that used in the Baltimore Eye Survey\(^2\) and the Blue Mountains Eye Study\(^3\); however, our study was limited in that we did not have fasting blood glucose measurements for participants. It is possible that we might have overestimated the prevalence of diabetes, because we relied on postprandial blood glucose measurements to define diabetes. It is unlikely that selection bias could have a role to play in this population, because a large proportion of those with either POAG or diabetes had not been diagnosed before the study.

Females were less likely to have POAG in our study even after adjusting for other potential risk factors. This is different from what has been seen in Andhra Pradesh of south central India,\(^4\) where the odds of females having POAG were 1.3 (95% CI, 0.7, 2.6), although this was not statistically significant. We have no explanation for these observations.

Data from our study suggest that a vertical cup-to-disc ratio > 0.5 should arouse suspicion of glaucoma in this population, because the median vertical cup-to-disc ratio in this population was 0.3 ± 0.2. Although ideal, it might not be logistically feasible for all patients to have threshold perimetry in economically poor nations; the use of vertical cup-to-disc ratios might be a better screening tool for glaucoma suspects in such populations. The vertical cup-to-disc ratio is a better indicator for suspicion of glaucoma in our population, because more than 50% of subjects whose IOP was less than 2 SD above the population mean had glaucomatous field defects, whereas none of those with vertical cup-to-disc ratios less than 2 SD above the population mean had glaucomatous field defects.

The prevalence of glaucoma, other than POAG, was low and did not allow us to perform any meaningful analysis. The prevalence of angle-closure glaucoma in our population is lower than that reported for Mongolia\(^5\) and Eskimos.\(^6\)

We can retard or delay visual function loss in most, but not all, patients with glaucoma if the disease is both detected and treated successfully.\(^7\)–\(^28\) It is a matter of concern that a potentially preventable cause of visual impairment and blindness, which is relatively common in this older population, is undetected and often leads to blindness.

References

21. Sommer A, Tielsch JM, Katz J, et al. Relationship between intraocular pressure and primary open-angle glaucoma among...


